AIR QUALITY SURVEY OF SUSPENDED PARTICULATES TOWN OF DRAYTON VALLEY

SEPTEMBER 1 TO NOVEMBER 29, 1990

Alberta
ENVIRONMENT
Environmental Assessment Division
Environmental Quality Monitoring Branch

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AIR QUALITY SURVEY - SUSPENDED PARTICULATES
TOWN OF DRAYTON VALLEY

September 1 to November 29, 1990

Prepared by:

Air Assessment Section
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SUMMARY

Alberta Environment has received complaints regarding wood and ash particulate fallout from residents of Drayton Valley since June of 1987. In response to these complaints, and at the request of the Town of Drayton Valley, Alberta Environment conducted suspended particulate monitoring programs in the fall of 1989 and 1990. The following report presents the results of the suspended particulate monitoring program undertaken in Drayton Valley in the fall of 1990.

Suspended particulates were monitored in the Drayton Valley region by a network of five high volume samplers from September 1 to November 29, 1990. Inhalable particulates were monitored by one dichotomous sampler from November 1 to 29, 1990. Four high volume samplers were located in the town of Drayton Valley while an additional sampler was situated at the airport, approximately 5 km north-northeast of town. Total dustfall was monitored at all five high volume monitoring locations from June 1, 1990 to January, 1991. A wind instrument was set up at one location to monitor prevailing winds in the Drayton Valley region.

High volume samplers will monitor all suspended particulates in the atmosphere while the dichotomous sampler will only monitor particulates that, when inhaled, may be deposited into the respiratory tract (e.g., nose, throat and lungs). The dustfall sampler will generally collect all suspended particulates plus larger particles which fall to the ground (i.e., wood chips and ash).

The results of the monitoring program indicated that 28% of total suspended particulate (TSP) samples exceeded the Alberta Environment regulation of 100 ug/m^3 (micrograms per cubic metre). This is almost twice the number of exceedances recorded in the 1989 study. The highest frequency of exceedances was recorded at a location in the southeast sector of town where industrial activity and vehicular traffic was at a maximum. TSP loadings at this location were, on average, greater than those observed in downtown Edmonton. Samples which exceeded the regulation were mainly composed of dust, ash and unburned wood particles.

Benzo (a) Pyrene (BaP), which is a component of wood smoke and vehicle exhaust, was detected at levels comparable with downtown Edmonton. The highest loadings of BaP were observed at two monitoring locations in the southwest sector of town and one monitoring location near a major traffic artery (50th Ave.). BaP in the region was probably generated by: (1) the wood processing industry when the winds were from the south and south-southwest directions; and (2) recreational and home wood burning as well as vehicular emissions when winds were from the west and northwest directions.

Elemental carbon is a common constituent of emissions from the wood processing industry and vehicle exhaust emissions. The greatest frequency of elevated carbon loadings was observed at the site situated

in the industrial area of Drayton Valley. Sources of carbon in the region were likely: (1) wood processing when the winds were from the south and southwest directions; and (2) recreational and home wood burning, and hydrocarbon emissions from automobiles when the winds were from the west and northwest directions.

Average inhalable particulate loadings were 45% of those recorded in 1989. This may be due to factors such as more snowcover in November of 1990 which would decrease the quantity of road and agricultural dust in the air, and, therefore decrease total loadings of inhalable particulates.

Total dustfall loadings exceeded Alberta Environment guidelines for residential areas at all monitoring sites located in the town of Drayton Valley. Dustfall guidelines for industrial areas were exceeded at one monitoring site. The organic component of dustfall was the highest at stations located in the southwest sector of town. Dustfall samples collected in town were found to contain wood particulates. Sources of dustfall in the Drayton Valley area include road dust, dust generated by agricultural activities, particulates produced by local industry and automobile emissions. The wood processing industry, recreational wood burning and automobile emissions are the most probable sources of organic dustfall in the region.

Results of the monitoring program indicate that TSP did exceed the Alberta Environment regulation. Possible sources of BaP and carbon in the Drayton Valley region were found to be the wood processing industry and vehicular exhaust. Wood particulates were likely produced by the wood processing industry with minor contributions from recreational wood burning.

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1. INTRODUCTION

Alberta Environment was requested by the Town of Drayton Valley to conduct a follow-up outdoor suspended particulate monitoring program in Drayton Valley during the fall of 1990. In response to this request, Alberta Environment established a network of five high volume samplers to monitor suspended particulates in the Drayton Valley area from September 1 to November 29, 1990. A dichotomous sampler was installed at site #1 during November, 1990, for the purposes of monitoring inhalable particulates (particles less than 10 microns in diameter which may be deposited into the respiratory tract). Wind speed and direction were also monitored at site #1. In addition to suspended particulates, total dustfall was monitored at each high volume monitoring site. The locations of the monitoring sites are indicated in Figure 1-1. Total suspended particulates and inhalable particulates were monitored for approximately the same time period as the 1989 study.

1.1 BACKGROUND

Alberta Environment conducted a suspended particulate monitoring program from September 5 to December 3, 1989, to assess suspended particulate loading in Drayton Valley from all sources.

Results of the 1989 monitoring program indicated that total suspended particulate (TSP) loadings exceeded the Alberta Environment regulation of 100 ug/m^3 (micrograms per cubic metre) in 13% of the samples collected by the high volume samplers. Particles identified in these samples were composed mainly of dust. The most likely sources of dust in the Drayton Valley region are road dust and dust generated during agricultural activities.

Wood particulates were identified as the dominant particulate in 23% of the high volume samples collected in 1989. TSP loadings in these samples did not exceed the Alberta Environment ambient air quality regulation. A wind direction frequency distribution revealed that the source of wood particulates was located in the southwest and south-southwest areas of Drayton Valley. A wood processing facility is located in the southwest sector of Drayton Valley.

Selected dichotomous samples (particulate size less than 10 microns) collected in 1989 were found to have high concentrations of

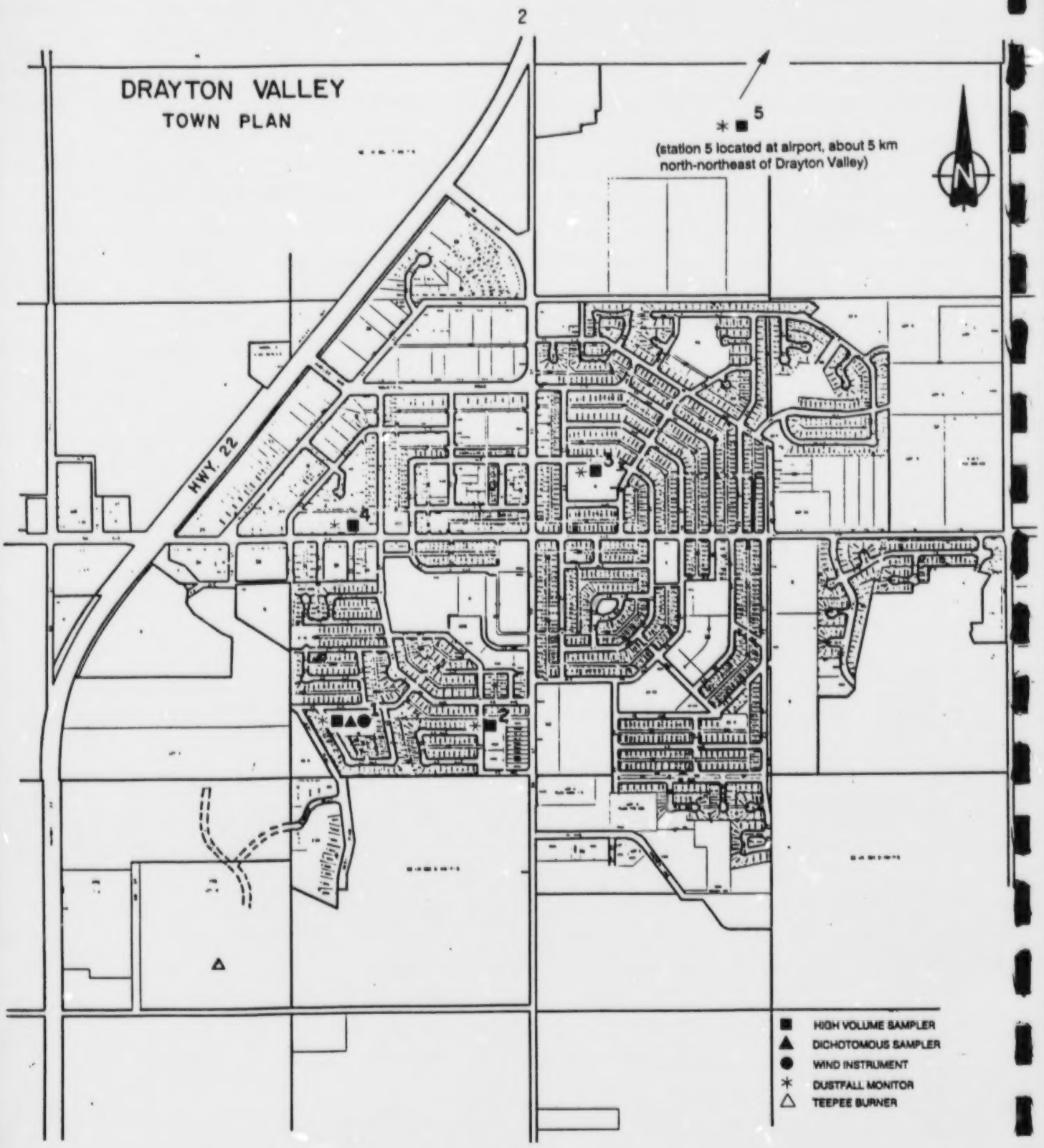

Figure 1-1 Location of suspended particulate monitoring network in 1990.

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lead, calcium and potassium. Lead is a common constituent of automobile emissions. Evidence suggests that a source of potassium, calcium, and iron is located to the southwest and south-southwest of Drayton Valley in the direction of a wood processing facility.

Detailed results of the 1989 suspended particulate monitoring program are presented in a separate report (Alberta Environment, 1990). A comparison of instrumentation used in the 1989 and 1990 monitoring programs is presented in Table 1.1.

Table 1.1 Comparison of instruments used in the 1989 and 1990 monitoring programs.

Monitoring Location	High Volume Sampler		Dichotomous Sampler		Wind Instrument		Dustfall Monitor	
	1989	1990	1989	1990	1989	1990	1989	1990
Site #1	x	x	x	x	x[a]	x		x
Site #2	x	x						x
Site #3	x	x						x
Site #4	x	x						x
Site #5		x						x

a - Instrument malfunction; data not used.

1.2 TOPOGRAPHY

Local topography is defined by the North Saskatchewan River which is oriented north-northeast to south-southwest and is located approximately 2.5 km east of the town. Terrain in the region consists of small, partially tree-covered hills with elevations generally decreasing towards the North Saskatchewan River. There is significant agricultural activity in the Drayton Valley region.

A small hill, with a northwest to southeast orientation, runs through downtown Drayton Valley. Terrain elevations to the northeast and southwest of this hill are somewhat lower than the downtown area. Local topography is illustrated in Figure 1-2.

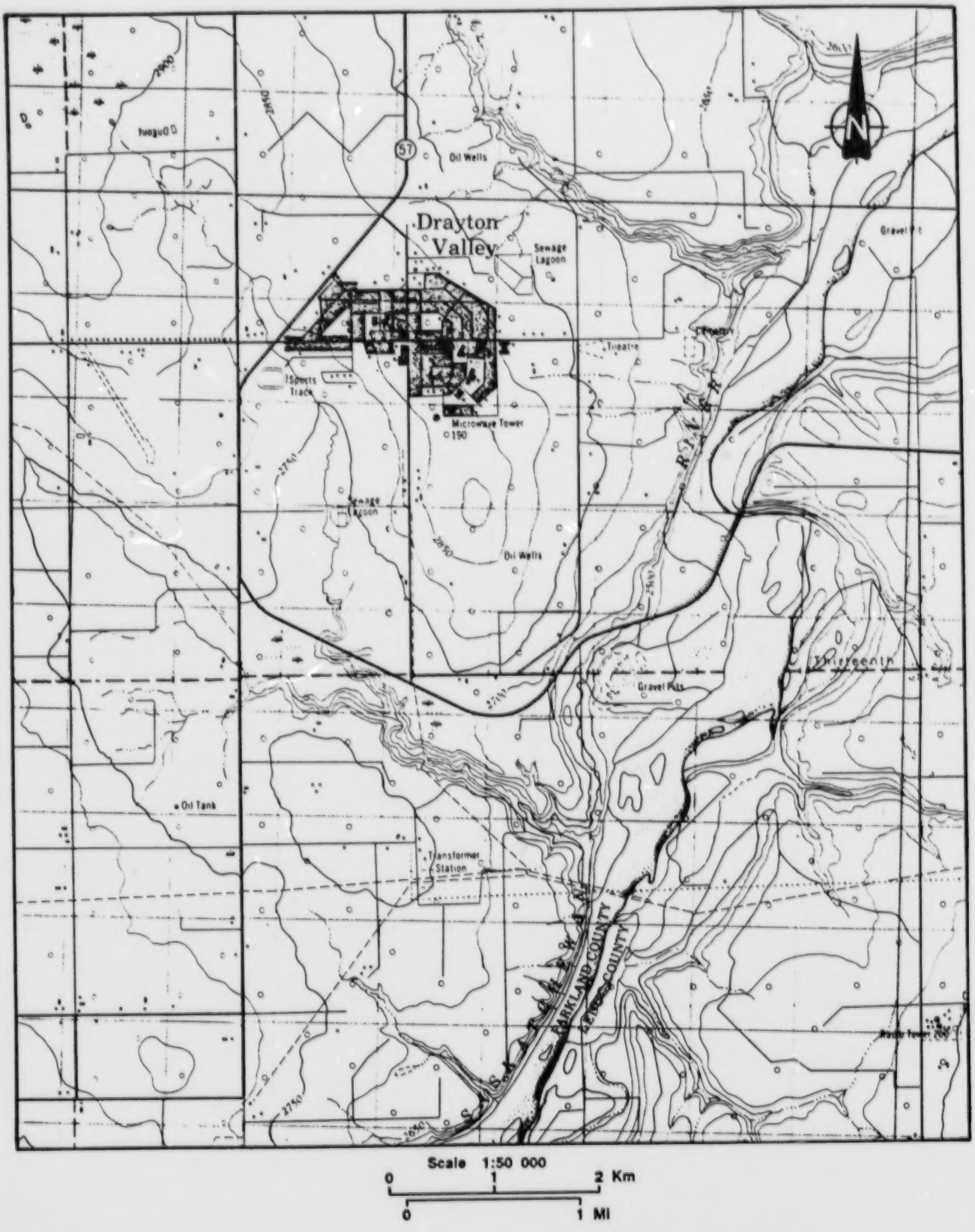

Figure 1-2 Topographical map of the Drayton Valley region.

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2. DESCRIPTION OF MONITORING PROGRAM

The monitoring program consisted of a network of five high volume samplers, one dichotomous sampler, one wind instrument and five total dustfall monitors. The high volume suspended particulate monitoring program was operated from September 1 to November 29, 1990 at all five monitoring sites. Wind speed and wind direction were also monitored at site #1 for this time period. Inhalable particulates were monitored by a dichotomous sampler from November 1 to 29, 1990 at site #1.

In addition to the suspended particulate monitoring program, total dustfall was monitored at the five high volume monitoring sites commencing on June 1, 1990. It is expected that total dustfall will continue to be monitored until May 31, 1991. Total dustfall data from June 1, 1990 to January 31, 1991 is available for inclusion in this report.

A description of the high volume sampler, dichotomous sampler, total dustfall monitor and wind instrument is presented in Appendix 8.1.

2.1 SITE DESCRIPTION

Sites #1 to #4 were situated at the same locations as the 1989 monitoring program. Site #5 was added to the most recent monitoring program for the purpose of monitoring suspended particulates and dustfall at a location that is not significantly influenced by particulate emission sources within the town.

Routine operation of monitoring instrumentation was conducted by volunteers who are residents of Drayton Valley. Weekly inspections of monitoring equipment was undertaken by technologists from Alberta Environment. Each monitoring site is described as follows:

- Site #1 - Located at 55 St. and 43 Ave. in a residential region of southwest Drayton Valley at the base of the hill running through downtown. Access to the site was on a grass-covered surface. A gas well-head is located near the site.

- Site #2 - Situated halfway up the hill towards downtown in the south part of town at 44 Ave. and 52 St. This site was located in a churchyard within close proximity to an unpaved back alley.
- Site #3 - Located a few blocks east of downtown at 52 Ave. and 50 St. on the top of the hill. Access to the site is by an unpaved road. A pumping oil well exist in the vicinity.
- Site #4 - Located in the west part of town near a main traffic artery running east-west through town (50th Ave.). This traffic artery is frequently utilized by heavy trucks. This site was located at approximately the same elevation as site #2.
- Site #5 - Located at Drayton Valley airport approximately 5 km northeast to north-northeast of town. Site is surrounded by the airstrip and pasture land. A gravel road is situated about 500 m away.

2.2 AIR QUALITY PARAMETERS AND REGULATIONS

Monitoring conducted by utilizing high volume samplers and dichotomous samplers will result in a direct measurement of atmospheric loadings of suspended particulates. Further analysis of particulate matter through high pressure chromatography and hydrofluoric acid digestion will reveal the constituents of particulate loading such as Benzo (a) Pyrene (BaP) and elemental carbon, respectively. Analysis of dustfall data will show the quantity total dustfall and the organic component of dustfall.

2.2.1 Total Suspended Particulates (TSP)

Air pollutants are not necessarily in the gaseous form. Tiny particles of solid material or liquid droplets, defined collectively as particulates, are also present in the atmosphere, and may constitute a pollution problem. These particles range in size from 0.001 to 500 microns (a human hair is about 100 microns in diameter) and, depending on their size and other properties, may remain suspended in the air for a few seconds or indefinitely.

In general, particles smaller than 1 micron in diameter originate in the atmosphere, primarily as a by-product of condensation and combustion. Particles between 1 micron and 10 microns in diameter usually include soil, process dusts, and combustion products from industries. Particles larger than 10 microns in diameter generally result from mechanical processes such as wind erosion, grinding, spraying and vehicular activity.

Since particulates enter the body through the respiratory system, most of their immediate effects are upon this system. The factor which determines the depth of penetration into the respiratory system is the particle size. Larger particles tend to be deposited in the upper respiratory tract, such as the nose and throat, while smaller inhalable particulates travel deeper into the lungs. Inhalable particulates are typically less than 10 microns aerodynamic diameter. The toxicity of the particles, however, varies with the chemical composition.

Suspended particulates may result from a variety of natural and man-made sources. These sources include soil, road dust, dust resulting from other human activities (i.e., agriculture), smoke from forest fires, smoke from recreational sources (i.e., camp fires and fireplaces), vehicular exhaust emissions, and industrial emission sources.

Regulations governing the maximum permissible levels of TSP are based on visibility reduction and nuisance effects. Alberta has adopted the most rigorous federal standards for maximum permissible TSP loadings:

- 100 ug/m^3 (micrograms per cubic metre) as a 24-hour total loading: and
- 60 ug/m^3 as an annual geometric average loading.

Monthly average TSP loadings in Alberta ranged from 10.5 to 34.9 ug/m^3 at Ellerslie (approximately 15 km south-southwest of downtown Edmonton) and 39.9 to 75.1 ug/m^3 at the Edmonton downtown monitoring station (based on 1989 data). Sources of particulates in the Edmonton downtown area are predominantly the result of vehicular emissions. The 24-hour regulation for TSP is frequently exceeded at the Edmonton and Calgary monitoring stations.

2.2.2 *Benzo (a) Pyrene (BaP)*

Benzo (a) Pyrene is an organic compound that belongs to a class of compounds known as polycyclic aromatic hydrocarbons (PAH). BaP is formed during the combustion of organic materials and is present in all types of soot and smoke. The prime sources are heat and power generation, refuse burning, coke production and motor vehicle emissions. BaP has also been detected in tobacco smoke, wood smoke from fireplaces and forest fires, and food stuffs such as smoked fish, charcoal broiled steaks, roasted coffee, vegetables and cereals (Jones et al., 1987).

Most sources of BaP have not been accurately characterized because of the variety of factors that influence BaP formation. For example, during the process of combustion, the amount of excess air, combustion temperature, fuel moisture content and feed conditions will affect the formation of BaP.

BaP loadings are obtained by high pressure chromatography analysis of high-volume sampler filters. The result is a 24-hour accumulated loading of BaP expressed in units of micrograms per 1000 cubic meters (ug/1000 m^3). Alberta currently has no ambient air quality regulations for BaP.

Measurements of BaP are recorded at various urban and rural locations in Alberta on a routine basis. In 1989, mean BaP loadings at the Edmonton downtown monitoring station ranged from 0.05 ug/1000 m^3 in July to 0.47 ug/1000 m^3 in December. The primary source of BaP at this location is likely vehicular emissions. Mean values of BaP measured at Ellerslie in 1989 ranged from 0.01 to 0.08 ug/1000 m^3. These lower values reflect the rural location of Ellerslie.

2.2.3 *Elemental Carbon*

Elemental carbon is a measure of organically-based materials which are present on the high volume filters. Inorganic particles contained on the filter are dissolved by digesting the sample with hydrofluoric acid, and treating the sample with ammonium hydroxide, nitric acid and hydrochloric acid. The remaining organic material is dried and ignited at 700°C. The difference in sample weight before and after ignition will reveal the quantity of elemental carbon.

Sources of carbon in the atmosphere include wood processing facilities, the combustion of natural gas, lamp black plants, refuse incineration and vehicle exhaust emissions. There are no ambient air quality regulations for elemental carbon in Alberta. Therefore, high volume samples are not routinely analyzed for elemental carbon by Alberta Environment.

2.2.4 Total Dustfall

Dustfall is described as a measurement of the fraction of particulate matter that does not remain suspended in the atmosphere for an indefinite period of time. Particles collected by dustfall monitors will generally have a larger diameter and mass than those collected as suspended particles by high volume samplers.

Dustfall may originate from a variety of natural and man-made sources. The most common sources are road dust, wind-blown soil, particles generated through agricultural activities, large particles emanating from industrial sources and ash from forest and recreational fires.

The guidelines adopted by Alberta Environment for total dustfall in the ambient air are as follows:

- 53 mg/100 sq cm/30 days (milligrams per 100 square centimetres per 30 days) in residential and recreational areas; and
- 158 mg/100 sq cm/30 days in commercial and industrial areas.

Dustfall was monitored at 13 networks by Alberta Environment in 1989. Average annual total dustfall loadings ranged from 36 mg/100 sq cm/30 days (milligrams per square centimeter per 30 days) at Sherwood Park to 107 mg/100 sq cm/30 days at Lethbridge. The average total dustfall loading at Edmonton in 1989 was 71 mg/100 sq cm/30 days. The residential and recreational guidelines for total dustfall are often exceeded at Alberta Environment monitoring locations.

2.2.5 Organic Dustfall

Total dustfall is analyzed to obtain fixed and organic components of dustfall. Total dustfall is the amount of material left

after the liquid is evaporated from the sample. The quantity of material remaining in the sample after ignition is the fixed, or inorganic portion of the dustfall sample. The difference between the total dustfall measurement and the fixed dustfall measurement is the quantity of organic material in the sample.

Organic dustfall would likely result from the coal and wood processing industries, as well as recreational and forest fires. At the present time, there is no regulation for organic dustfall in Alberta.

Total dustfall samples are routinely analyzed for organic and fixed dustfall portions by Alberta Environment. At Sherwood Park and Lethbridge dustfall monitoring networks, average organic dustfall was 23 and 36 mg/100 sq cm/30 days in 1989, respectively. This corresponds to about 63 and 34% of total dustfall originating from organic materials, respectively, for Sherwood Park and Coleman monitoring networks. The average organic dustfall loading at Edmonton in 1989 was 28 mg/100 sq cm/30 days. This is about 39% of the average total dustfall loading in Edmonton.

3. DATA ANALYSIS AND RESULTS

Data collected by high volume samplers were weighed to quantify the total suspended particulate loading. Selected high volume samples underwent further analysis to reveal particle identification, BaP loading and elemental carbon loading on the filter. Analysis of TSP, BaP and carbon loadings as related to wind direction are presented.

Dichotomous data was analyzed for particulate loading in the coarse (2.5 to 10 microns) and fine (< 2.5 microns) fractions. Further analysis of dichotomous samples was not possible due to the unavailability of X-ray fluorescence instrumentation at the Alberta Environmental Centre. Dustfall samples were analyzed for total dustfall and organic dustfall.

Wind data and suspended particulate data are presented in the Appendices 8.2 and 8.3, respectively.

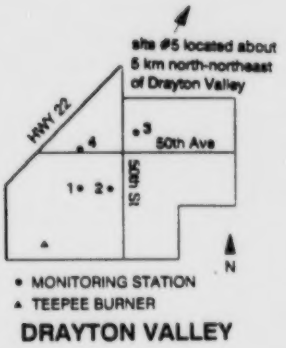
3.1 ANALYSIS OF WIND DATA

A wind direction frequency distribution of data collected at monitoring site #1 during September, October and November, 1990 is presented in Figure 3-1. The predominant wind directions during this monitoring period were west to north-northwest (37%) and south-southeast to south-southwest (30%). Winds from the east and east-southeast were the least frequent during September, October and November at site #1.

Filters from the high volume and dichotomous samplers were changed between 10:00 a.m. and 11:00 a.m. everyday. Wind data from site #1 were analyzed on a 24-hour basis, from 11:00 a.m. to 10:00 a.m. for September, October and November, 1990. This would enable a direct comparison of wind data with the results from the high volume sampling program.

3.2 TOTAL SUSPENDED PARTICULATES (TSP)

A total of 432 high volume samples were collected during the monitoring program. Of these samples, 18 were rejected due to instrument malfunction. The remaining 414 samples were weighed to quantify TSP loading. Figures 3-2 to 3-4 show TSP loading as a function



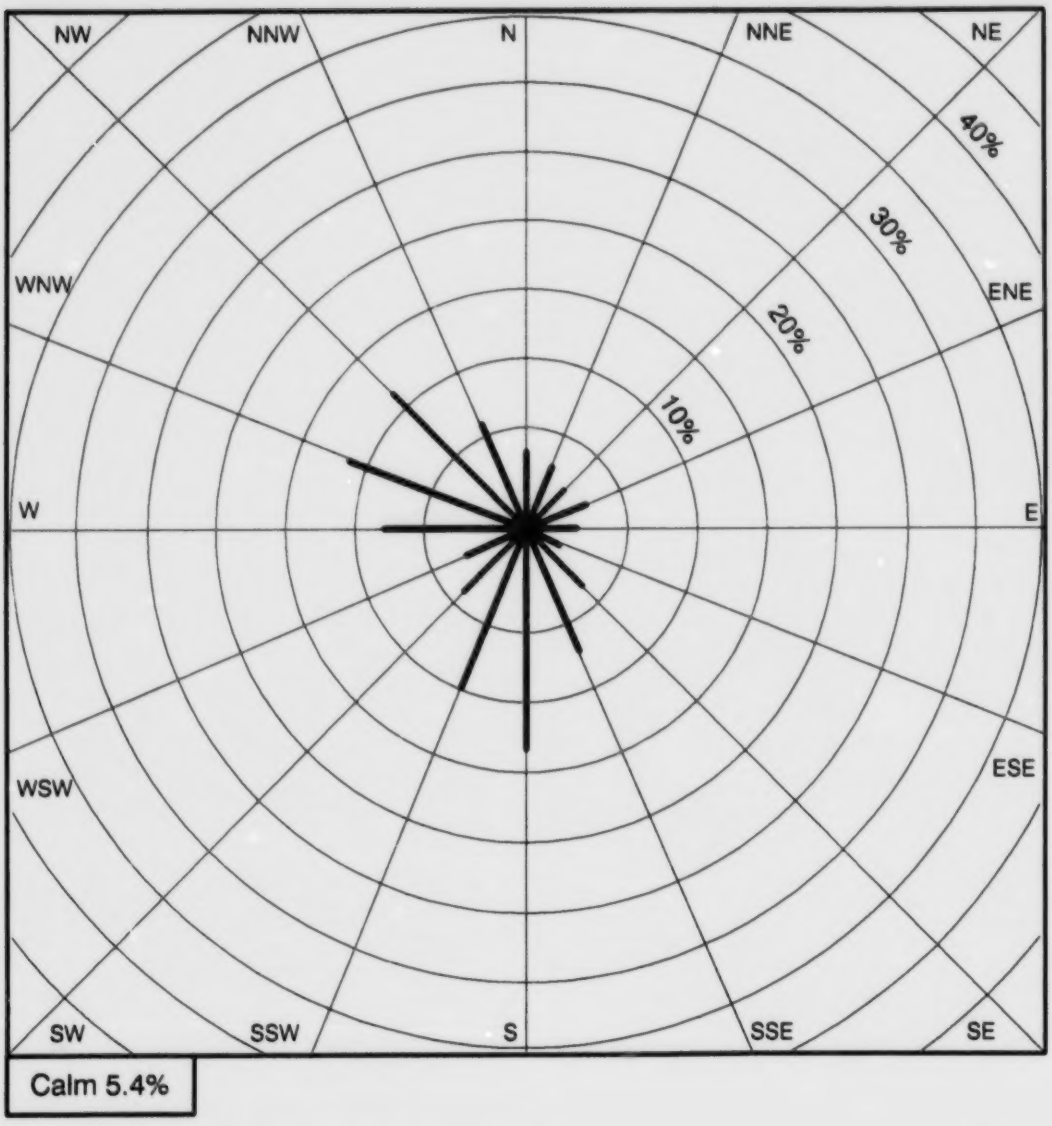


Figure 3-1 Wind direction frequency distribution for September, October and November 1990.

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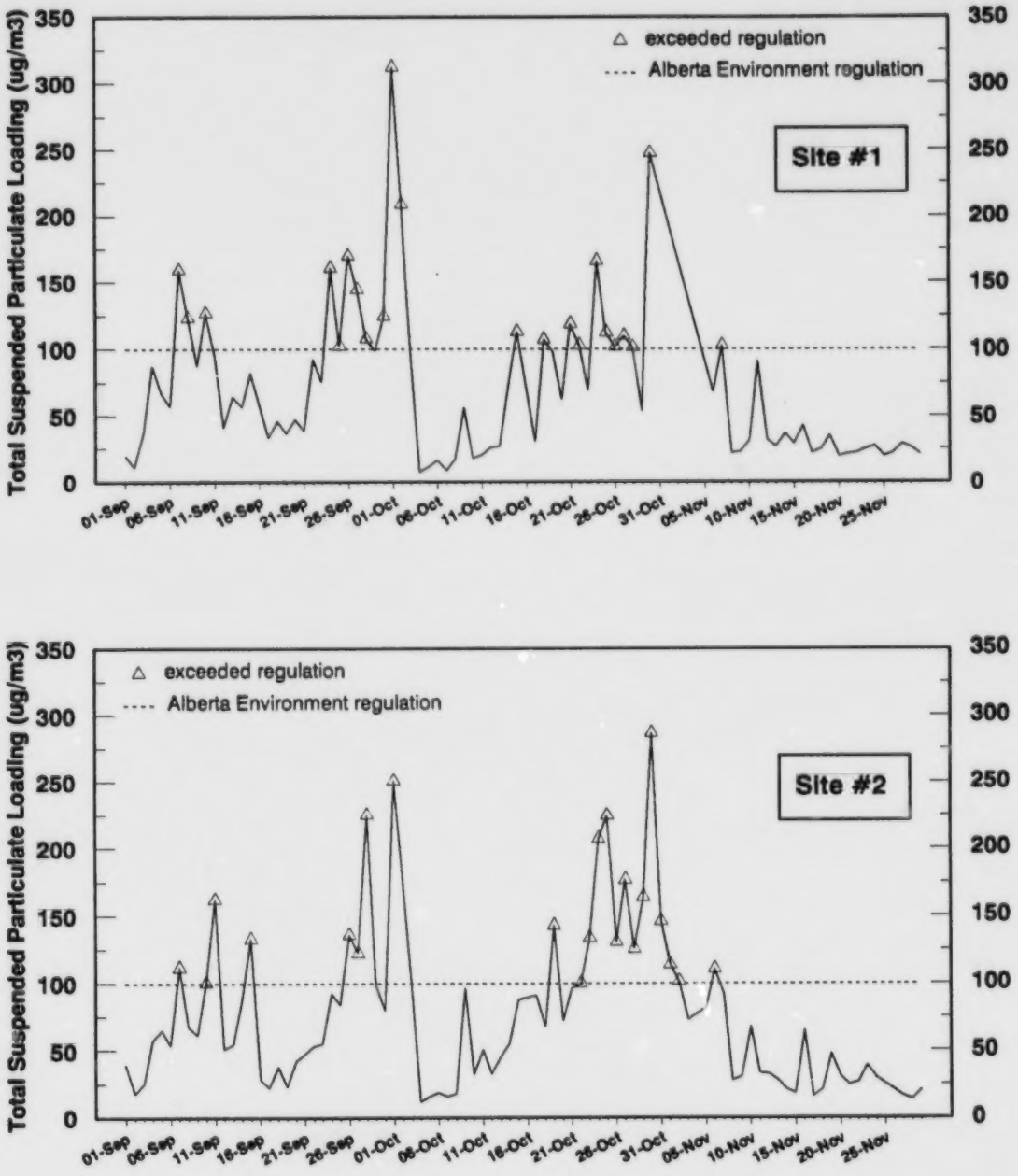

Figure 3-2 Total suspended particulate loading as a function of day at sites #1 and #2.

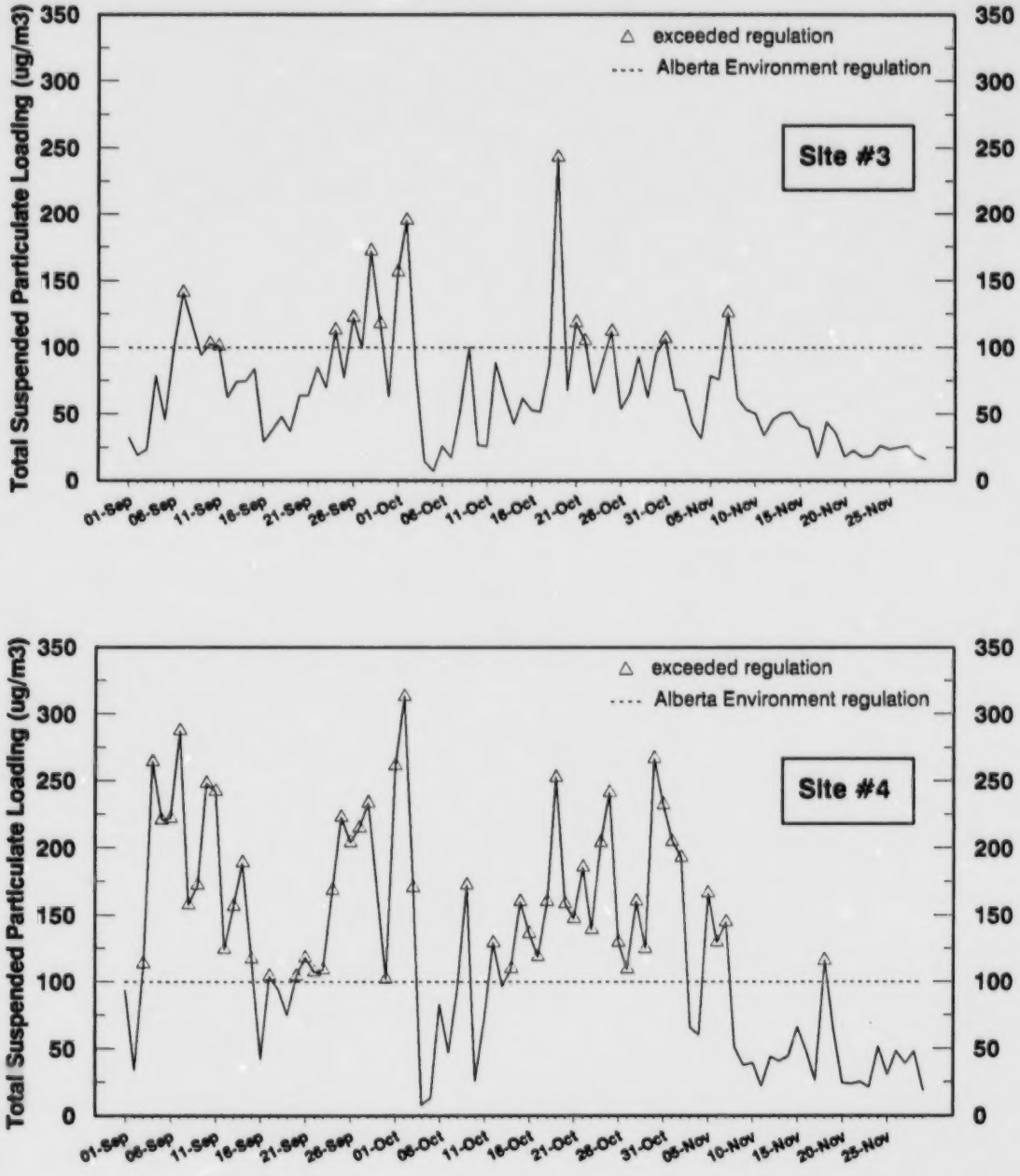

Figure 3-3 Total suspended particulate loading as a function of day at sites #3 and #4.

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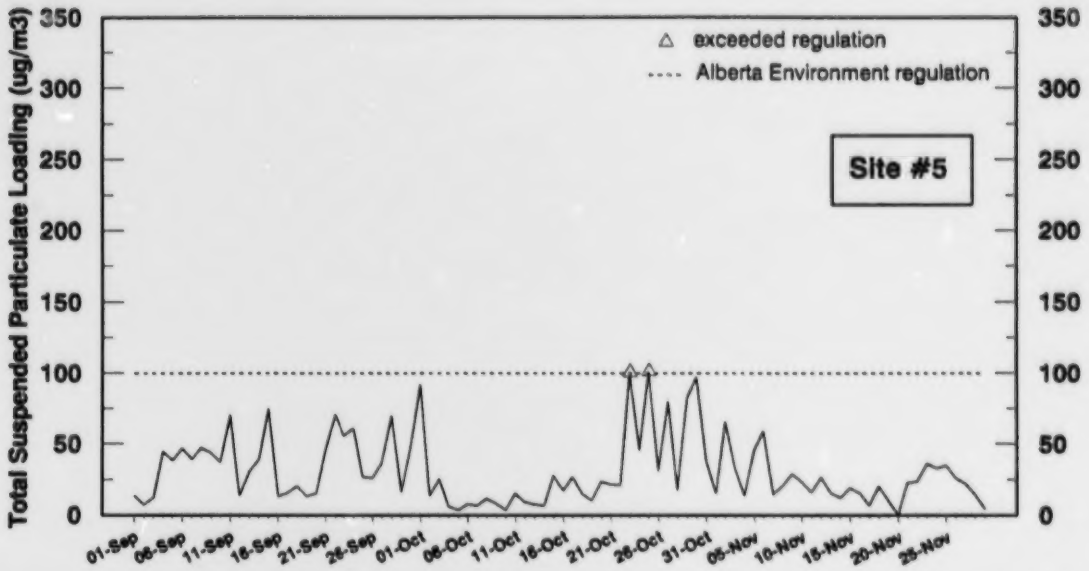

Figure 3-4 Total suspended particulate loading as a function of day at site #5.

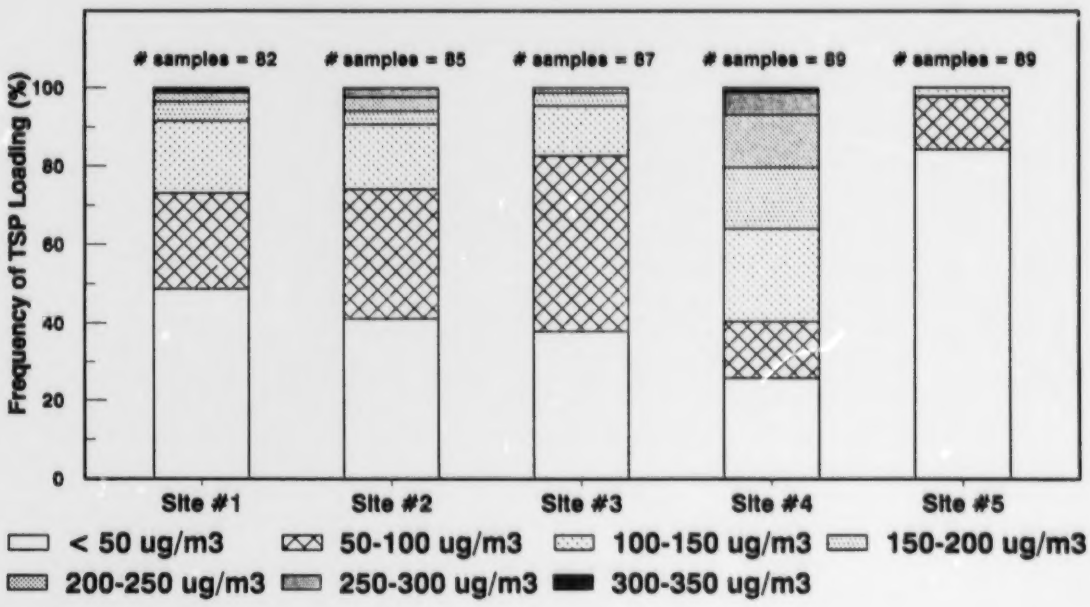

Figure 3-5 Frequency distribution of TSP loading.

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of day at sites #1 to #5. Samples which exceeded the Alberta Environment regulation of 100 ug/m^3, as a 24-hour accumulated loading, are indicated in these figures.

A total of 28% (114 samples) of high volume samples exceeded the Alberta Environment regulation. The percentage of exceedances ranged from 2% (2 samples) at site #5 to 60% (53 samples) at site #4. An abrupt decrease in the frequency of samples which exceeded the regulation is visible on November 7 and 8 at all monitoring sites. This observation coincides with the occurrence of the first permanent snowcover in Drayton Valley. Figure 3-5 (see page 15) shows a frequency distribution of TSP loading at each monitoring location.

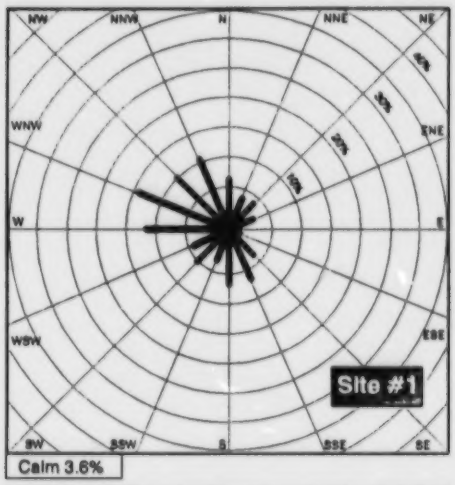
An exceedance of the regulation was recorded at one or more sites on 54 days during the 90-day monitoring period. A wind direction frequency distribution for days on which an exceedance of the regulation was recorded is presented in Figure 3-6 for sites #1 to #5.

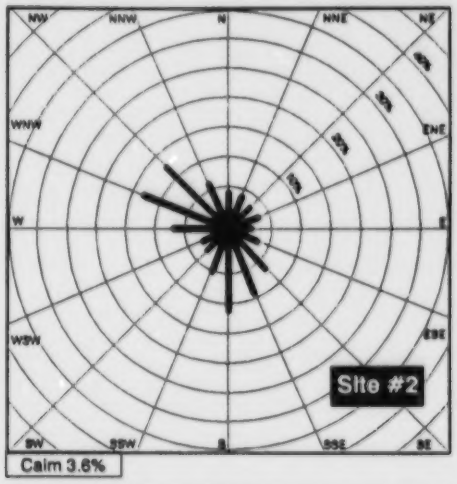
At sites #1 to #4, exceedances were most common when winds were from the west to north-northwest directions. Relatively high frequencies of winds from the south-southeast and south directions are also evident at sites #2 to #4 when exceedances are recorded. Winds from the north-northeast and south-southeast to south-southwest are the most frequent on the two days which exceeded the regulation for TSP at site #5.

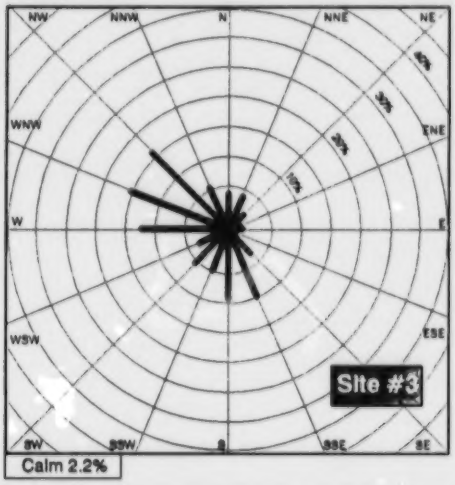
A total of 28% (116 samples) of high volume samples which were visually identified as containing wood particles underwent electron microscopy analysis to identify the particles present in the sample. These samples were found to be composed of burned and unburned wood particles, ash and dust. The quantity of each particulate type could not be identified. About 53% (61 samples) of these samples exceeded the regulation for TSP.

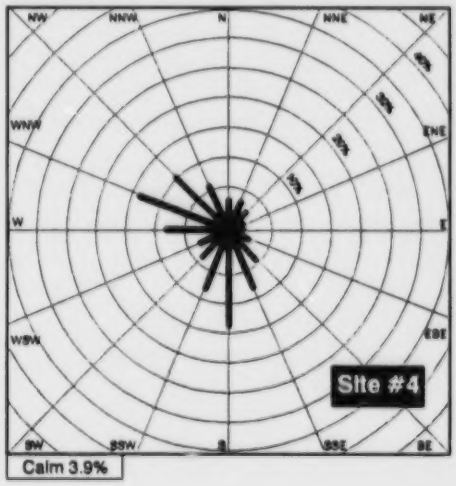
3.3 BENZO (a) PYRENE (BaP)

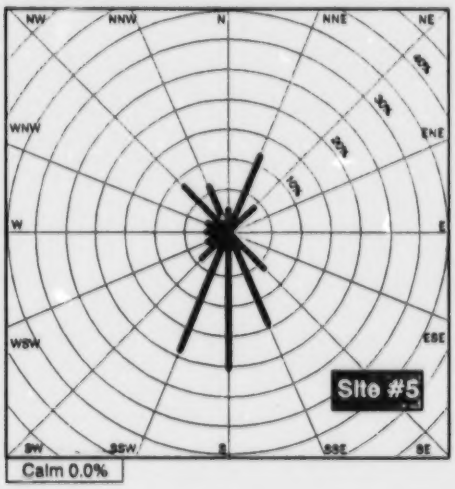
High pressure chromatography was applied to: (1) the 114 samples that exceeded the Alberta Environment regulation for TSP loading; and (2) an additional 31 samples that were visually identified as containing smoke (appeared grey or black in colour). This analysis quantified the loading of BaP in the sample.











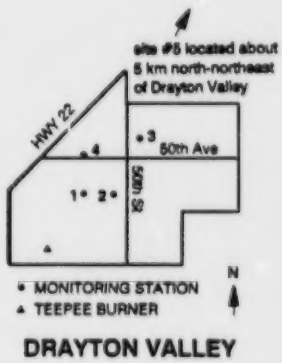


Figure 3-6 Wind direction frequency distribution for days on which exceedances were observed.

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BaP loadings as a function of day are presented in Figures 3-7 to 3-9 for sites #1 to #5. The highest BaP loadings generally occurred in November at sites #1, #2 and #4. Some high BaP loadings are also evident in October at site #4.

Figure 3-10 shows a frequency distribution of BaP loadings at each high volume monitoring site. It is important to note the number of samples analyzed for BaP per site when reviewing this figure. The highest frequency of low BaP loadings was evident at sites #3 and #5 where approximately 88% (15 samples) and 100% (2 samples) were below 0.25 ug/1000 m^3. The highest frequency of samples that exceeded 0.25 ug/1000 m^3 was observed at sites #1 and #2 where 46% (16 samples) and 56% (19 samples) were greater that 0.25 ug/1000 m^3, respectively. The overall maximum BaP loading was recorded at site #2 where a value of 1.97 ug/1000 m^3 was recorded on November 12. Relatively high BaP loadings were also recorded on November 12 at sites #1 (1.63 ug/1000 m^3) and #4 (1.73 ug/1000 m^3). Average BaP loadings ranged from 0.05 ug/1000 m^3 at site #5 to 0.40 ug/1000 m^3 at site #1. The maximum BaP loading recorded in downtown Edmonton in 1989 was 1.48 ug/1000 m^3. This value is about 75% of the maximum loading recorded in Drayton Valley in 1990.

3.3.1 Elevated BaP Loadings

As stated in Section 2.3.2, the maximum monthly average BaP loading recorded at the Edmonton downtown monitoring location in 1989 was 0.47 ug/1000 m^3. This value was recorded in December. Therefore, BaP loadings greater than 0.5 ug/1000 m^3 may be considered as elevated BaP loadings relative to observed values in downtown Edmonton.

Approximately 14% of all samples analyzed for BaP recorded a value greater than 0.5 ug/1000 m^3. These samples are indicated by a dashed line in Figures 3-7 to 3-9. The frequency of samples that exceeded 0.5 ug/1000 m^3 ranged from 0% at sites #3 and #5 to 23% (8 samples) at site #1. A wind direction frequency distribution for days with elevated BaP loadings is presented in Figure 3-11 for sites #1, #2 and #4.

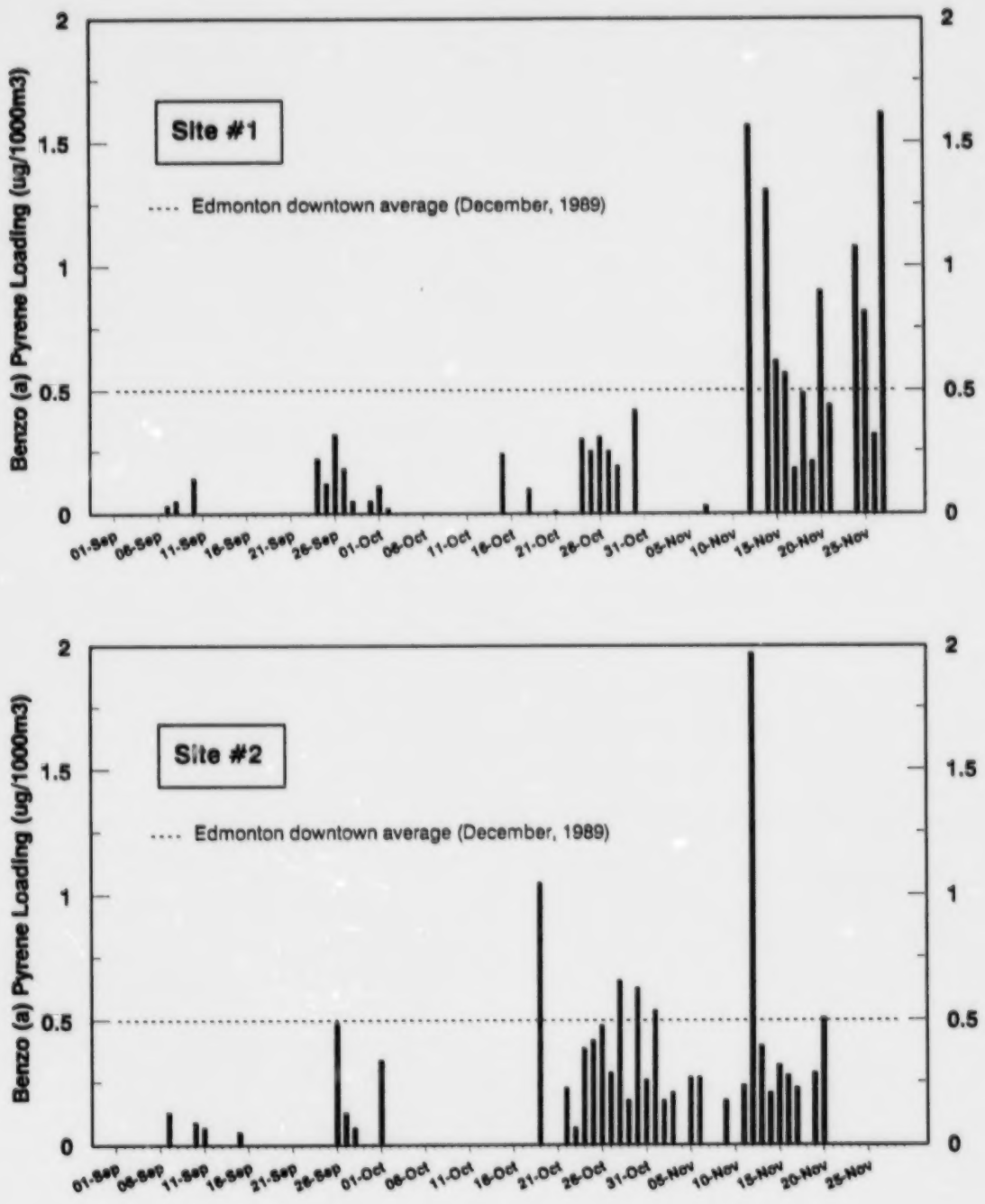


Figure 3-7 Benzo (a) Pyrene loading as a function of day at sites #1 and #2.

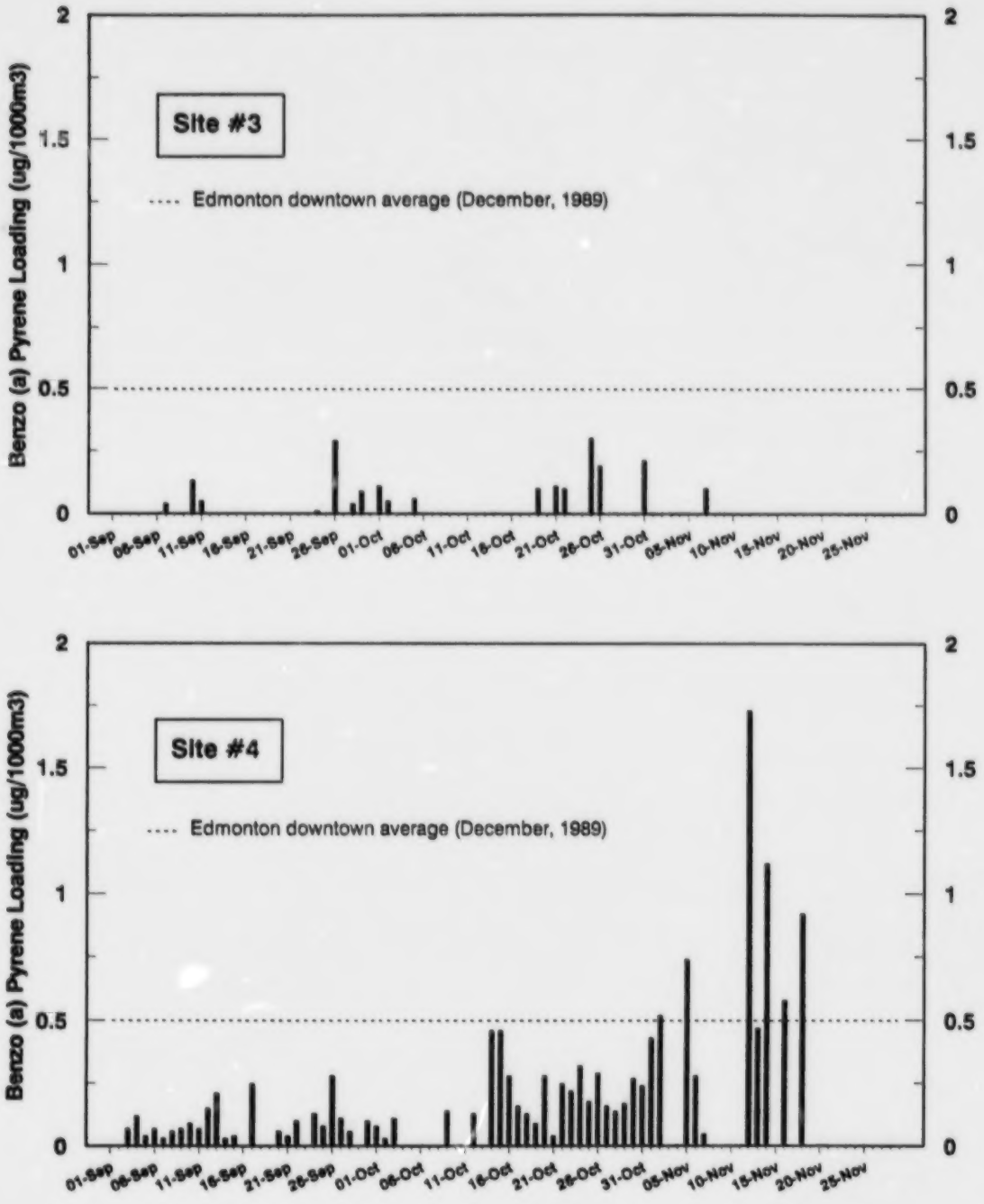


Figure 3-8 Benzo (a) Pyrene loading as a function of day at sites #3 and #4.

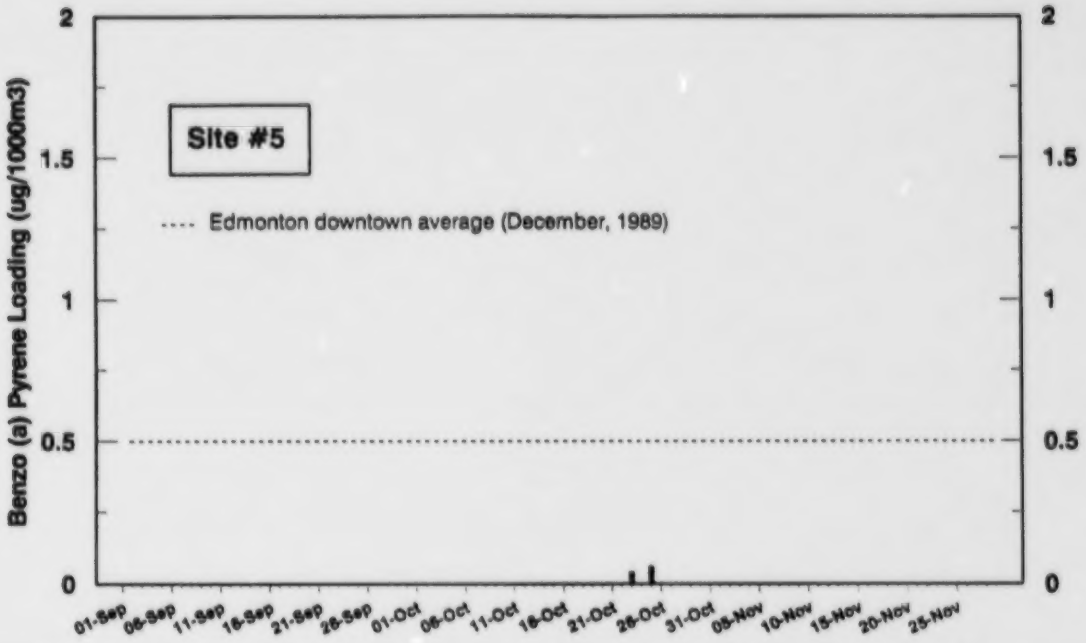


Figure 3-9 Benzo (a) Pyrene loading as a function of day at site #5.

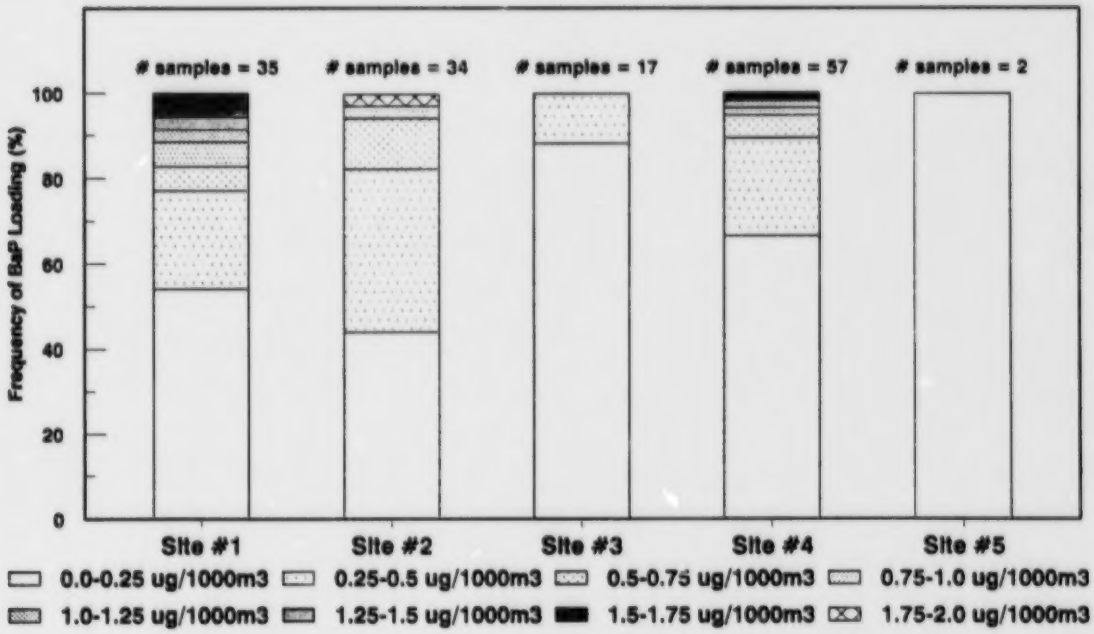
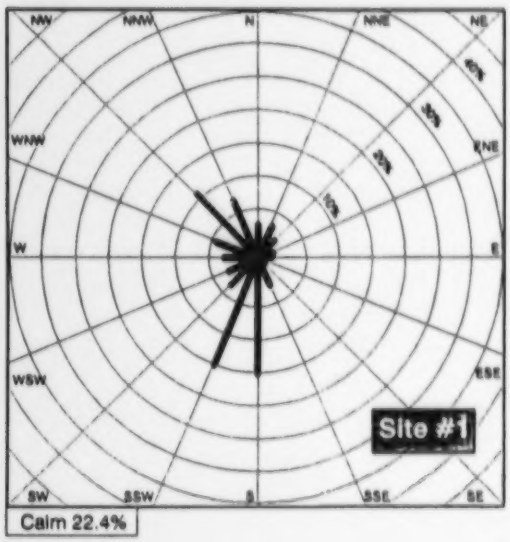
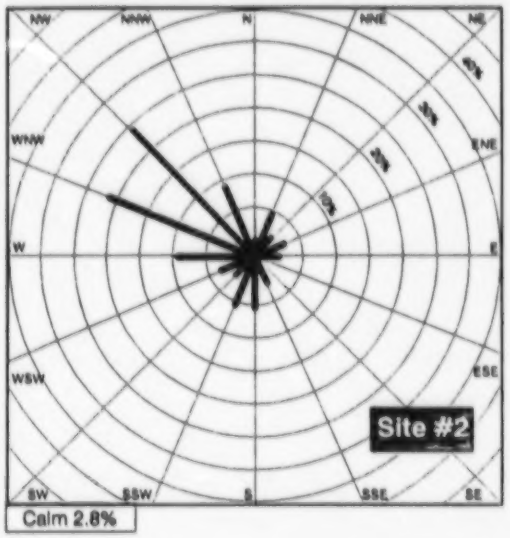
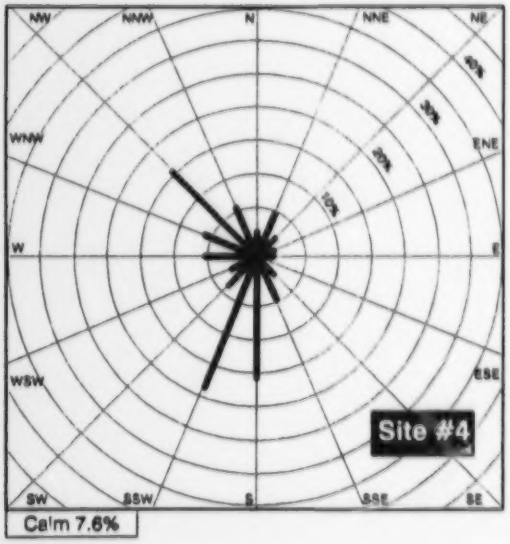


Figure 3-10 Frequency distribution of BaP loading.







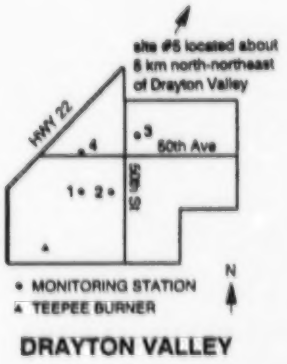


Figure 3-11 Wind direction frequency distribution for days which had elevated BaP loadings.

At site #1, the predominant wind directions during days with elevated BaP were south and south-southwest. Winds were from these two directions approximately 31% of the time. A substantial frequency of winds from the northwest and north-northwest directions (18%) was also evident. Light and variable, or calm winds, were observed about one-fifth (22%) of the time when elevated BaP loadings occurred at site #1.

At site #2, the prevalent wind directions during days with high BaP loadings were west-northwest and northwest. Approximately 46% of winds were from these directions when BaP loadings at site #2 were greater than 0.5 ug/1000 m^3.

The predominant wind directions at site #4 during high BaP days were south and south-southwest (35%). Approximately 15% of winds were from the northwest when BaP loadings were greater than 0.5 ug/1000 m^3 at site #4.

3.4 ELEMENTAL CARBON

All high volume samples which exceeded the Alberta Environment regulation for TSP underwent further analysis to quantify carbon loadings within the sample. A total of 114 samples were analyzed for elemental carbon. Analysis for elemental carbon was not conducted on samples that appeared grey or black in colour.

Carbon loadings as a function of day are indicated in Figures 3-12 to 3-14. The highest carbon loadings were generally observed in late October at all monitoring locations. Relatively high carbon loadings were also visible in September and early October, especially at site #4. Carbon analysis was conducted on only a few samples in November because TSP loadings were generally below the regulation. Maximum carbon loadings ranged from 21.8 ug/m^3 at site #5 to 40.0 ug/m^3 at site #4.

A frequency distribution for carbon loading is presented in Figure 3-15. When examining this figure, it is important to note the number of samples per site that were analyzed for elemental carbon. The frequency of samples which exceeded 10 ug/m^3 ranged from one-half of samples at site #1 (11) to all samples (2) at site #5. One-third of the 114 exceedance samples had carbon loadings greater than 10 ug/m^3.

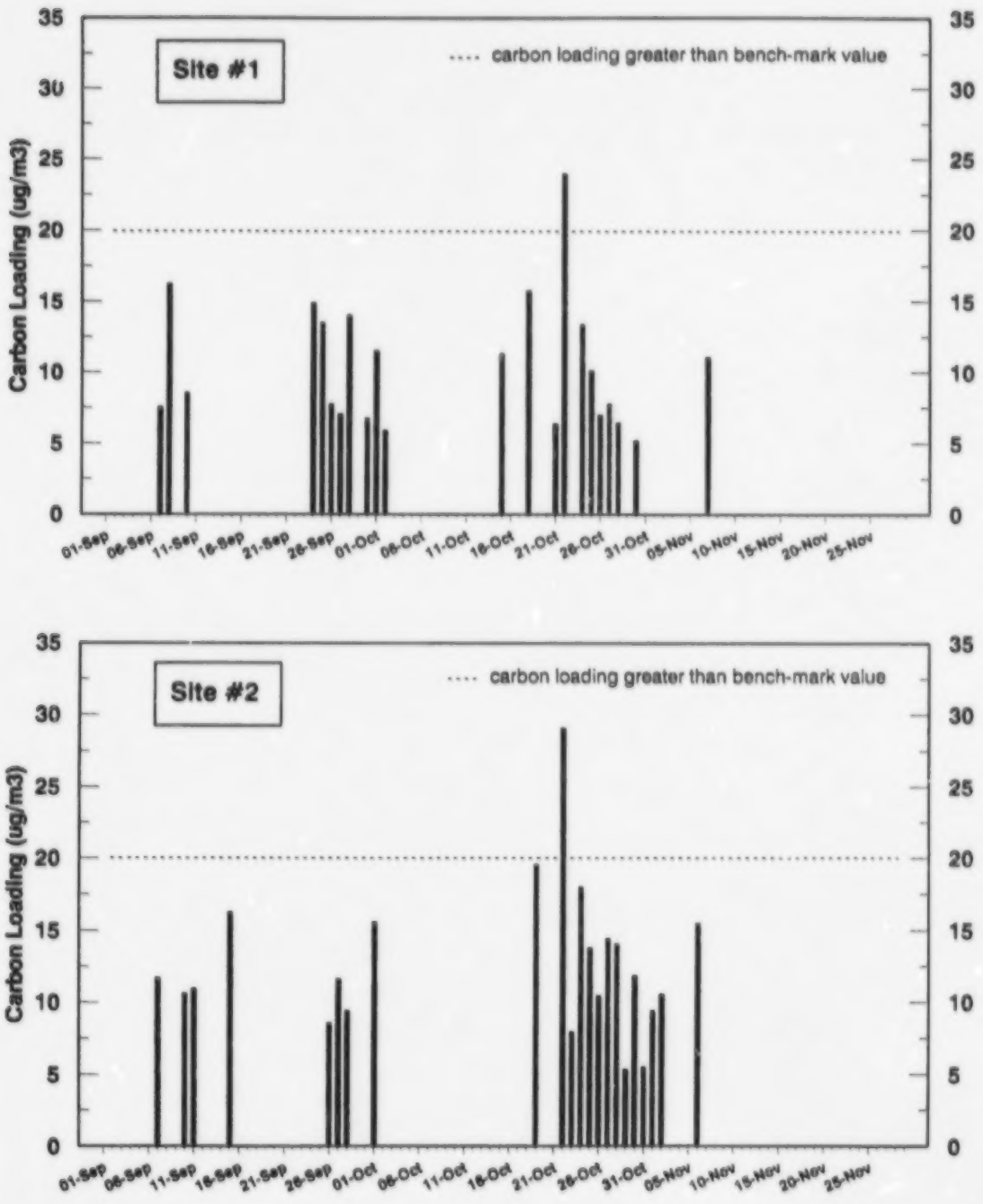
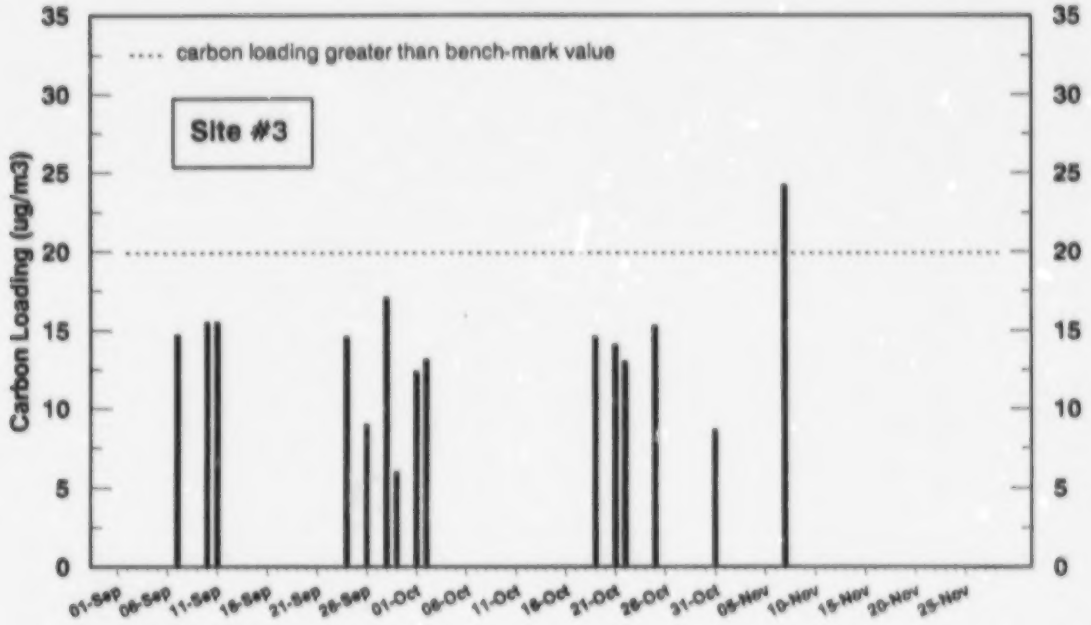


Figure 3-12 Carbon loading as a function of day at sites #1 and #2.



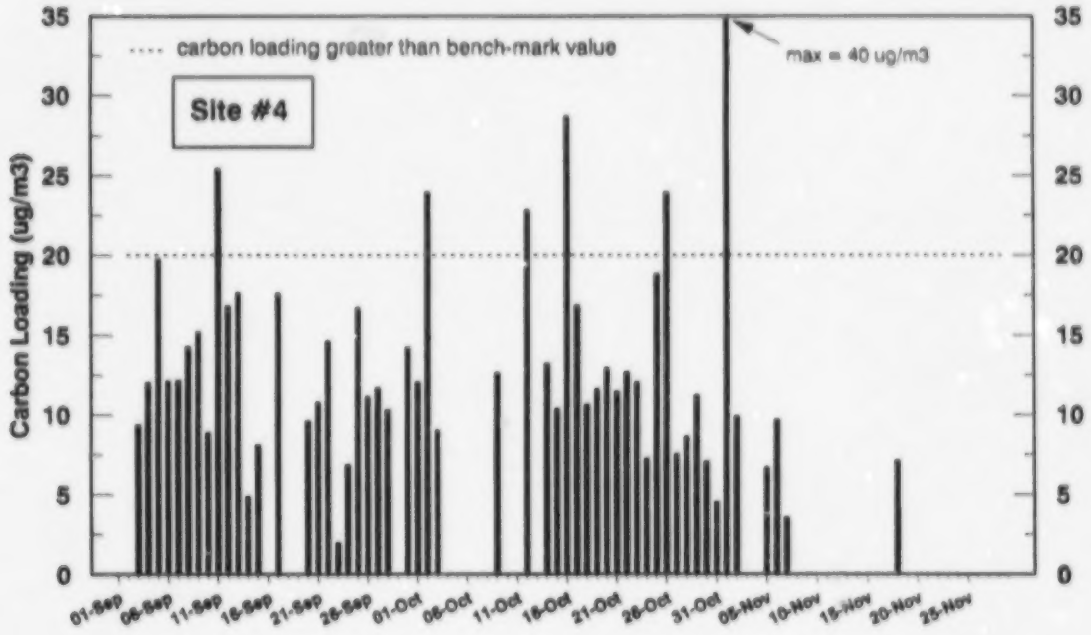


Figure 3-13 Carbon loading as a function of day at sites #3 and #4.

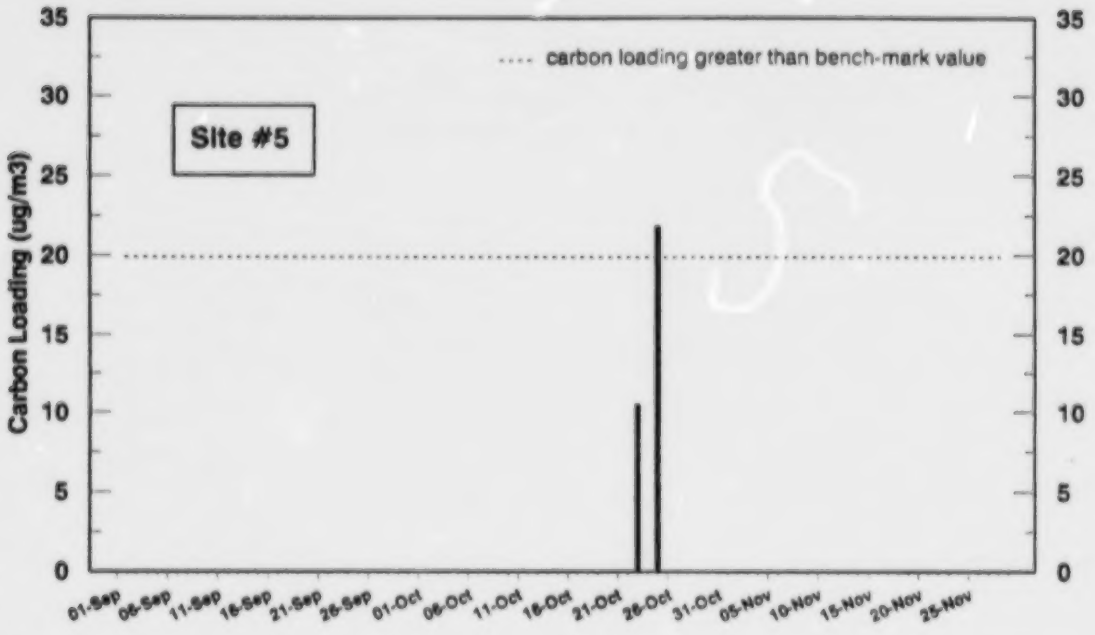


Figure 3-14 Carbon loading as a function of day at site #5.

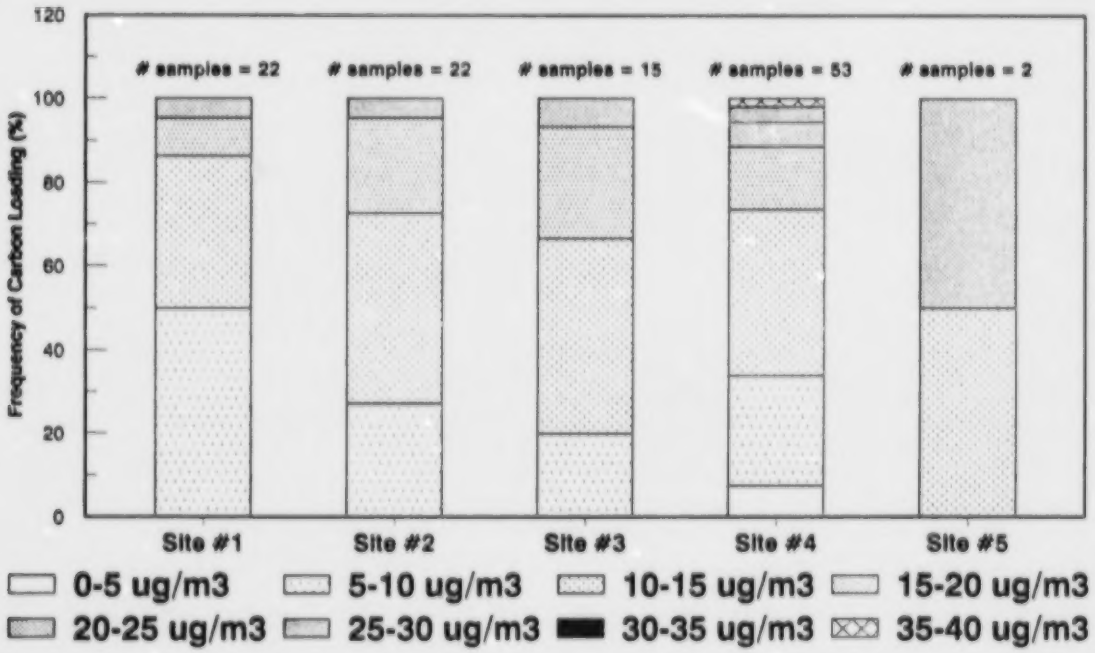


Figure 3-15 Frequency distribution of carbon loading.

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3.4.1 *Elevated Elemental Carbon Loadings*

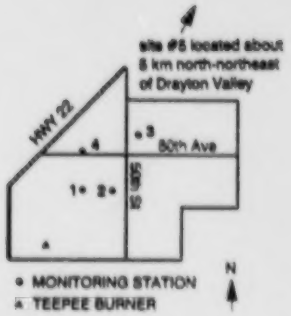
Since elemental carbon analysis is not routinely conducted on high volume samples, it is difficult to establish a bench-mark value which relates to elevated carbon loadings. A value of 20 ug/m^3 was arbitrarily chosen to delineate elevated carbon loadings in exceedance samples. Approximately 9% (10 samples) of samples analyzed for elemental carbon were above the bench-mark value. Elemental carbon loadings greater than 20 ug/m^3 are indicated by the dashed line in Figures 3-11 to 3-13. The number of samples which exceeded 20 ug/m^3 ranged from one observation at sites #1, #2, #3 and #5 to six observations at site #4.

On October 22, the carbon loading at sites #1 and #2 exceeded the 20 ug/m^3 bench-mark. Winds on this date were primarily from the west and west-northwest (58%) although, 25% of the winds were from the south direction (Figure 3-16). At site #3, carbon loadings exceeded the bench-mark value on November 7. The majority of the winds on this date were from the south-west to west directions (79%). Winds on the six days which recorded carbon loadings greater than 20 ug/m^3 at site #4 were predominantly from the west to northwest directions (49%). At site #5, carbon loadings exceeded the bench-mark value on October 25. Prevailing winds on this date were from the northwest and north-northwest directions (29%) and the north-northeast direction (25%).

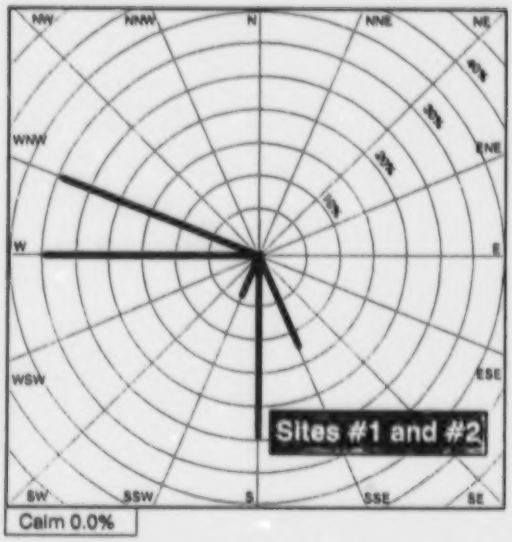
3.5 *INHALABLE PARTICULATES*

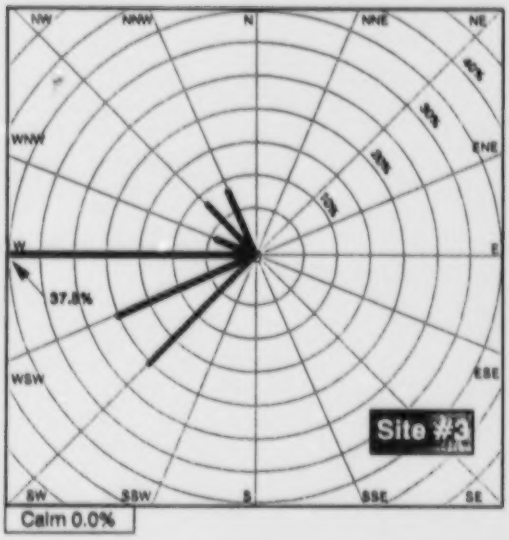
A dichotomous sampler was installed at site #1 from November 1 to 29 to obtain loadings of inhalable particulates in the fine (less than 2.5 microns) and coarse (2.5 to 10 microns) fractions. Dichotomous data is not available from November 1 to 5 due to loss of power to the site. A total of 24 samples were available for analysis. Particulate loadings for these samples are listed in Table 3-1.

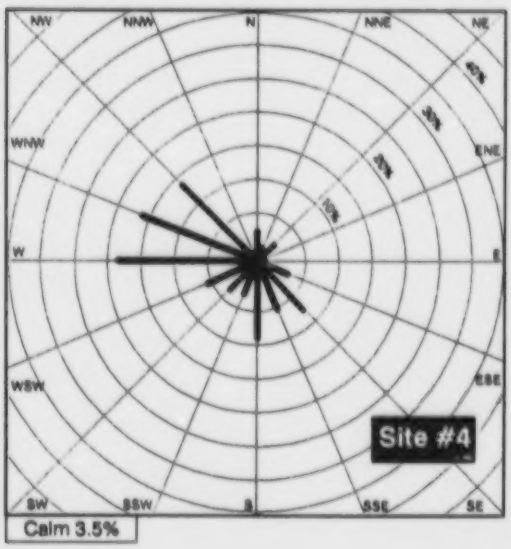
Average and maximum fine particulate loadings were 14 and 42 ug/m^3, respectively. The average particulate loading in the coarse fraction was 10 ug/m^3 while the overall maximum loading was 29 ug/m^3. Average and maximum total inhalable particulate (less than 10 microns in diameter) loadings were 24 and 54 ug/m^3, respectively. Only one



DRAYTON VALLEY







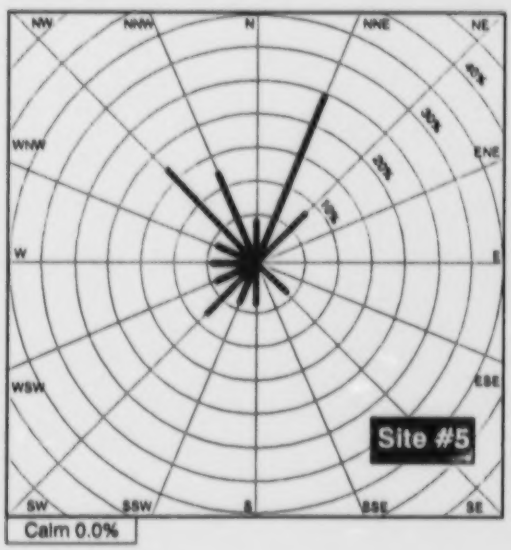


Figure 3-16 Wind direction frequency distribution for days which had carbon loadings greater than 20 ug/m^3.

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Table 3-1. Fine and coarse particulate loadings at site #1.

Date Sampled	Fine (< 2.5 microns) (ug/m^3)	Coarse (2.5-10 microns) (ug/m^3)	Total (ug/m^3)
Nov-06-90	13	19	32
Nov-07-90	8	29	38
Nov-08-90	8	8	17
Nov-09-90	8	12	21
Nov-10-90	13	17	29
Nov-11-90	21	13	33
Nov-12-90	25	4	29
Nov-13-90	21	4	25
Nov-14-90	12	8	21
Nov-15-90	13	12	25
Nov-16-90	21	8	29
Nov-17-90	0	8	8
Nov-18-90	8	8	17
Nov-19-90	21	13	33
Nov-20-90	8	0	8
Nov-21-90	21	21	42
Nov-22-90	17	4	21
Nov-23-90	25	12	37
Nov-24-90	8	0	8
Nov-25-90	12	0	12
Nov-26-90	4	8	12
Nov-27-90	42	12	54
Nov-28-90	8	4	13
Nov-29-90	8	8	17
Average	14	10	24

observation exceeded the California ambient air quality guideline for inhalable particulates (less than 10 microns) of 50 ug/m^3.

3.6 TOTAL DUSTFALL

Total dustfall was collected, as a monthly accumulated loading, at all five high volume monitoring locations. Dustfall data from June, 1990 to January, 1991 underwent laboratory analysis to assess total dustfall loading and the organic portion of the dustfall loading. A total of 39 samples were analyzed for this 8-month period. Two samples were not analyzed due to contamination from foreign materials.

Total and organic dustfall loadings at each monitoring site are presented in Table 3-2. Average total dustfall loadings ranged from 11.2 mg/100 sq cm/30 days at site #5 to 65.4 mg/100 sq cm/30 days at site #4. Maximum total dustfall loadings for the monitoring period were observed in the months of October and June at site #4 where values of 208.9 and 127.6 mg/100 sq cm/30 days were recorded, respectively.

Exceedances of the residential guideline for total dustfall of 53 mg/100 sq cm/30 days were recorded at sites #1 to #4. The highest number of exceedances were recorded at sites #2 and #4 where three months showed values greater than the regulation at each of these two locations. There was one value which exceeded the industrial guideline for total dustfall of 158 mg/100 sq cm/30 days. This exceedance was recorded in October at site #4. The number of exceedances at each monitoring site are indicated in Table 3-3.

Average organic dustfall loadings ranged from 4.8 mg/100 sq cm/30 days at sites #3 and #5, respectively, to 22.5 mg/100 sq cm/30 days at site #2. The two highest organic dustfall loadings were observed at site #2 with values of 55.5 and 59.3 mg/100 sq cm/30 days occurring in September and July, respectively.

With the exception of site #1, total and organic dustfall loadings drop off substantially for the months when the ground is snowcovered (November to January) compared to months when the ground is bare (June to October). This result suggests that road and agricultural dust are likely major contributors to organic and total dustfall loadings in the summer and fall, before the first permanent snowfall occurs. Snowcover will tend to sharply reduce the amount of road and agricultural dust emitted into the atmosphere.

At sites #1 to #4, located in the town of Drayton Valley, all dustfall samples collected throughout the monitoring period contained wood and ash particles. Wood particles were not evident in any samples collected at site #5.

Table 3-2. Total and organic dustfall loadings (mg/100 sq cm/30 days).

Month	Site #1		Site #2		Site #3		Site #4		Site #5	
	Total	Organic	Total	Organic	Total	Organic	Total	Organic	Total	Organic
Jun	84.8	38.7	66.8	24.5	51.6	16.1	127.6	29.0	*	*
Jul	25.2	1.1	97.2	59.3	21.8	1.2	50.2	6.6	35.8	12.6
Aug	14.1	3.5	35.8	15.6	52.2	16.9	13.7	4.6	13.7	5.2
Sep	46.5	16.7	108.3	55.5	36.8	9.7	53.4	10.4	10.4	2.1
Oct	45.1	11.8	*	*	47.9	13.9	208.9	38.2	1.4	1.4
Nov	28.6	12.6	18.3	5.8	13.0	6.1	23.1	6.9	3.4	1.3
Dec	35.9	15.6	19.1	8.6	16.2	7.5	17.0	8.0	9.6	7.7
Jan	68.5	33.4	31.6	10.8	16.2	10.0	29.3	10.0	3.9	3.1
Average	43.6	16.6	47.1	22.5	32.0	10.2	65.4	14.2	11.2	4.8

* sample contaminated

Table 3-3. Number of total dustfall loadings which exceeded the guideline.

	Number of Exceedances				
	Site #1	Site #2	Site #3	Site #4	Site #5
Residential Guideline	2 (25%)	3 (43%)	1 (13%)	3 (38%)	0 (0%)
Industrial Guideline	0 (0%)	0 (0%)	0 (0%)	1 (13%)	0 (0%)

4. SUMMARY OF RESULTS

4.1 TOTAL SUSPENDED PARTICULATES (TSP)

A total of 414 high volume samples were analyzed for TSP loading. Of these samples, about 28% exceeded the Alberta Environment regulation for TSP of 100 ug/m^3 as a 24-hour loading.

Winds were predominantly from the west to northwest directions on days when the regulation was exceeded. Relatively high frequencies of south-southeast and south wind directions were also recorded on these days. These wind directions do not differ substantially from prevailing wind directions of the region for the monitoring period.

TSP loadings at sites #1 to #4 were greater than those recorded in downtown Edmonton. Average TSP loadings ranged from 65.7 ug/m^3 at site #2 to 123.1 ug/m^3 at site #4. These values are somewhat higher than the range of monthly average TSP loadings observed at the Edmonton downtown monitoring station in 1989 (39.9 ug/m^3 to 75.1 ug/m^3). Average TSP loadings at site #5 are comparable to the upper range of monthly average TSP loadings at Ellerslie (Ellerslie is representative of typical rural TSP loadings).

About 28% of all samples were found to contain wood particles, ash and dust. Over half of these samples exceeded the regulation for TSP. Dust particles are much more dense than wood particles and therefore, would contribute more to the overall weight, or loading, of TSP samples. Since the regulation for TSP is based on weight, samples which contain mainly dust are much more likely to exceed the regulation than samples composed of wood particles.

Sources of suspended particulates in the Drayton Valley region are likely road dust, dust generated during agricultural activities and particulate matter produced by local industry and vehicular emissions. The contribution of dust to supended particulate readings is reflected in the dramatic decrease in exceedances observed after November 7, when the first permanent snowfall occurred. The increase in snowfall would serve to effectively dampen the amount of road dust and agricultural dust generated.

4.2 BENZO (a) PYRENE (BaP)

A total of 114 exceedance samples and 31 samples which appeared to contain smoke (appeared grey or black in colour) underwent laboratory analysis to quantify loadings of BaP. The highest BaP loadings were generally recorded in November with some high values also observed in October at site #4. On average, the highest BaP loadings occurred at site #1.

Benzo (a) Pyrene loadings in excess of 0.5 ug/1000 m^3 were recorded at sites #1, #2 and #4. A wind direction frequency distribution generated for days with high BaP loadings (in excess of 0.5 ug/1000 m^3) indicated that winds were primarily from the south and south-southwest directions at sites #1 and #4. Winds with a northwest component were also common at sites #1, #2 and #4 when high BaP loadings were recorded. Light and variable, or calm winds, were evident about 22% of the time when BaP loadings were high at site #1.

Average BaP loadings observed at sites #1 and #2 are similar to those in downtown Edmonton. For example, average BaP loadings at sites #1 and #2 were 0.40 and 0.36 ug/1000 m^3, respectively, compared to a range of 0.05 to 0.47 ug/1000 m^3 at the Edmonton downtown monitoring location in 1989. Average BaP loadings at site #5 are of the same range as those observed at Ellerslie.

Sources of BaP in the Drayton Valley region include: (1) wood processing facilities when winds are from the south or south-southwest; and (2) vehicular emissions (especially heavy duty vehicles) and recreational wood burning (i.e.; fireplaces and camp fires) when winds are from the northwest. Elevated BaP loadings cannot be related to one individual source in the region.

4.3 ELEMENTAL CARBON

All samples which exceeded the regulation for TSP were analyzed for elemental carbon. Additional samples which were identified as containing smoke (grey or black in colour) were not analyzed for elemental carbon.

A total of 114 samples were analyzed for elemental carbon. Average elemental carbon loadings ranged from 10.6 ug/m^3 at site #1 to

16.2 ug/m^3 at site #5 although, only two samples were analyzed for carbon at site #5. Maximum carbon loadings ranged from 21.8 ug/m^3 at site #5 to 40.0 ug/m^3 at site #4.

West to northwest winds were common on days which exceeded 20 ug/m^3 of carbon at sites #1, #2 and #4. High frequencies of south winds were also evident when elevated carbon loadings occurred at sites #1 and #2. The majority of winds were from the west and southwest when carbon loadings exceeded 20 ug/m^3 at site #3.

Further analysis of high volume samples which appeared grey or black in colour was not possible. Analysis of these samples may have revealed high carbon loadings.

Sources of carbon in the region are likely the result of: (1) wood processing facilities when the wind was from the south to southwest directions; and (2) recreational wood burning and hydrocarbons emitted by vehicles when winds are from the west to northwest directions. It is difficult to resolve the source of carbon at site #5 in late October. These relatively high readings may be the related of organic material present in the air resulting from agricultural activities in the vicinity.

4.4 INHALABLE PARTICULATES

A total of 24 samples of fine (< 2.5 microns) and coarse (2.5 to 10 microns) were collected during November at site #1. Average fine and coarse particulate loadings were 14 and 10 ug/m^3, respectively. The average total (fine + coarse) inhalable particulate loading was 24 ug/m^3. Further analysis of dichotomous data to resolve the constituents of particulate loading was not possible due to the unavailability of laboratory instrumentation.

4.5 TOTAL DUSTFALL

Dustfall samples collected from June, 1990 to January, 1991 were analyzed to quantify total and organic dustfall loadings. With the exception of site #5, exceedances of the residential guideline for total dustfall were recorded at all monitoring sites; the highest frequency of exceedances measured at sites #2 and #4. Average total dustfall readings

were the highest at site #4 (65.4 mg/100 sq cm/30 days) and the lowest at site #5 (11.2 mg/100 sq cm/30 days).

The average total dustfall loading at site #4 is close to the average total dustfall observed in the Edmonton network in 1989 (71 mg/100 sq cm/30 days). Total dustfall loadings recorded at site #5 were lower than most monthly dustfall observations recorded at Alberta Environment monitoring networks in 1989.

Average organic dustfall was the highest at sites #1, #2 and #4 with values of 16.6, 22.5 and 14.2 mg/100 sq cm/30 days, respectively. These values are similar to those observed at the Sherwood Park monitoring network in 1989, but somewhat lower than organic dustfall loadings measured at Edmonton in 1989. Dustfall originating from organic materials ranged from about 22% at site #4 to 48% at site #2 of total dustfall.

Wood particles were visually identified in all dustfall samples collected at sites #1 to #4. Wood particles were not evident in any samples collected at site #5, located near the Drayton Valley airport.

5. COMPARISON WITH PREVIOUS MONITORING ACTIVITIES

The frequency of exceedances recorded in the 1990 suspended particulate monitoring program was more than twice that observed in the 1989 study (e.g., 13% in 1989 versus 28% in 1990). Winds on days that recorded exceedances conformed to prevailing wind directions. The major sources of particulates which lead to exceedances are road and agricultural dust. Wood particles were present in over half of the samples that exceeded the regulation in the 1990 study.

Prevailing wind directions for September, October and November 1990 were similar to those observed for the same period in 1989. The main difference was a lower frequency of southwest and south-southwest wind directions in 1990 (e.g., about 23% of winds in 1989 versus 14% in 1990 were from the southwest and south-southwest directions). A greater frequency of south winds and winds with a northeast component were evident in 1989.

Table 5-1 lists average TSP, BaP and inhalable particulate loadings at each monitoring station for the 1989 and 1990 studies. TSP loadings were substantially higher during the 1990 monitoring program at all monitoring locations. For example, at site #4 the average TSP loading was twice that recorded in 1989. The increase in TSP loadings in 1990 may be due to: (1) an increase in industrial or agricultural activities; (2) an increase in the frequency of wind directions which transport particulate matter from the source(s) to the monitoring sites; and/or (3) an increase in weather conditions which lead to an accumulation of suspended particulates in Drayton Valley.

Average BaP loadings at sites #1 and #4 were similar for both 1989 and 1990 studies. The average BaP loading in 1989 was found to be higher at site #2. In the 1989 study, BaP was found to originate from sources in the south-southwest and southwest areas of Drayton Valley for samples that were visually discoloured by smoke. Winds from other directions were infrequent on these days. High BaP values measured in 1990 were found to emanate from sources in the south, south-southwest and northwest directions. The discrepancy in the wind direction frequencies between the 1989 and 1990 studies is likely related to the number of samples analyzed for BaP (i.e., 24 samples in 1989 compared to

Table 5-1. Comparison of results obtained from 1989 and 1990 suspended particulate monitoring programs.

	1989		1990	
	Average Loading	# of Samples	Average Loading	# of Samples
ISP(ug/m^3)[a]				
Site #1	47.2	89	69.5	82
Site #2	43.3	90	65.7	85
Site #3	42.9	82	66.4	87
Site #4	62.4	87	123.1	89
Site #5	NA	NA	31.1	89
BaP($ug/1000m^3$)[a]				
Site #1	0.40	10	0.40	35
Site #2	0.54	6	0.36	34
Site #3	NA	0	0.12	17
Site #4	0.26	8	0.25	57
Site #5	NA	NA	0.05	2

Inhalable Particulates(ug/m^3)[b]

	Fine	Coarse	Total	# of Samples	Fine	Coarse	Total	# of Samples
Site #1	24	29	53	24	14	10	24	24

a data obtained by high volume samplers
b data obtained by a dichotomous sampler
NA not applicable

145 samples in 1990) and therefore, the number of days included in the wind direction frequency distribution (i.e., 9 days in 1989 compared to 20 days in 1990). The larger sample size obtained in 1990 is more representative of all sources of BaP in the Drayton Valley region.

Loadings of inhalable particulates for a 24-day period in November, 1990 were found to be substantially lower than inhalable particulate loadings monitored for approximately the same time period in 1989. For example, average fine and coarse particulates loadings in 1990 were 58% and 34% of those recorded in 1989. Total inhalable particulate loadings in 1990 were 24 ug/m^3 as compared to 53 ug/m^3 in 1989. This is a reduction of 45% from 1989 to 1990 in total inhalable particulate loadings.

6. CONCLUSIONS

The 1990 suspended particulate monitoring program consisted of a network of five high volume samplers, one dichotomous sampler and one wind instrument. In addition to suspended particulates, dustfall was monitored at all five monitoring locations. The conclusions attained in this monitoring program are outlined below:

1. Total suspended particulate loadings exceeded the regulation of 100 ug/m^3 as a 24-hour loading in 28% of the samples collected. The highest frequency of exceedances was at site #4, which is located in an area of town with the highest density of industrial activity and heavy duty vehicular traffic. Particle identification revealed that 28% of high volume samples were composed of ash, unburned wood particulates and dust. Over half of these samples exceeded the 24-hour regulation for TSP. The contribution of road and agricultural dust to these exceedances is illustrated by the abrupt decrease in exceedances after the first permanent snowfall on November 7, 1990.

2. Benzo (a) Pyrene was detected at levels comparable with those recorded in downtown Edmonton. Approximately 14% of samples analyzed for BaP contained a loading greater than 0.5 ug/1000 m^3. The greatest number of elevated BaP readings were recorded at sites #1 and #2. These sites are located in the southwest sector of town. A relatively high frequency of elevated BaP loadings was also evident at site #4, which is located close to a major traffic artery (50th Ave.). A wind direction frequency distribution showed that most elevated BaP loadings originated from sources to the south and south-southwest of sites #1 and #4 and to the west and north-northwest of site #2. Sources of BaP in Drayton Valley are likely: (1) industrial wood burning facilities when the winds were from the south and south-southwest directions; and (2) recreation wood burning and vehicular

emissions when the winds were from the west and northwest directions.

3. Carbon loadings greater than 20 ug/m^3 were found in 9% of samples which exceeded the regulation for TSP. Sources of elevated carbon loadings were found to be located in the west to west-northwest and south to south-southeast directions at sites #1 and #2. At site #3, the dominant wind directions were from the west to southwest when elevated carbon values were measured. Most elevated carbon loadings emanated from sources in the west and northwest at site #4. Elevated carbon levels in the Drayton Valley are likely the result of: (1) wood processing when the wind were from the south and southwest directions; and (2) recreational wood burning and hydrocarbons emitted by vehicles when the winds were from the west and northwest directions.

4. Average inhalable particulate loadings monitored in 1990 were about 45% of those monitored over the same time period in 1989. A possible explanation for this is that road dust and agricultural dust were less in 1990 due to the ground being covered by snow for the majority of the time during November.

5. Total dustfall loadings exceeded guidelines established for residential areas on at least one occasion at all monitoring sites. The industrial guideline for total dustfall was exceeded at site #4. Total dustfall loadings at site #4 were close to those observed in Edmonton. The other monitoring stations recorded dustfall loadings that were generally much lower than at site #4. Common sources of dustfall in the region include road and agricultural dust, and particles generated by industrial activities and vehicular emissions.

6. The organic portion of dustfall was the highest at sites #1 and #2, which are located in the southwest sector of town, and site #4, located in the industrialized southeast sector of town. Visual observations indicated that wood particles (ash and unburned wood) were evident in all dustfall samples collected in the town of Drayton Valley.

7. Lower levels of TSP, inhalable particulates and dustfall were evident after November 7, 1990, when the ground was snowcovered. This result suggest that road and agricultural dust are the major contributors to particulate and dustfall loadings in Drayton Valley. Particulate and dustfall loadings may be predominantly due to industrial emission sources in the town with lesser contributions from vehicular exhaust and recreational wood burning after November 7.

7. REFERENCES

Alberta Environment. 1990. Air quality survey - suspended particulates: Town of Drayton Valley. Environmental Quality Monitoring Branch, Environmental Assessment Division. Alberta Environment.

Environment Canada. 1983. Dichotomous sampler evaluation project and filter evaluation project for particulate sulphates. Progress Report No. 2. Environmental Protection Service.

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8. APPENDICES

8.1 INSTRUMENTATION

8.1.1 High Volume Sampler

The high volume sampler consists of a vacuum system and filter housed in a shelter and operates on the same principle as a vacuum cleaner. The suspended particulate matter in the atmosphere is collected by drawing a known volume of air through a pre-weighed filter for a 24-hour period. Suspended particulates with a diameter range from 0.1 to 100 microns, Stokes equivalent, will be collected on the filter (Environment Canada, 1973). The filter is then re-weighed to determine the mass of the particles collected. The total particulate loading for the 24-hour period may then be calculated.

High volume samplers are calibrated in the laboratory at the beginning and end of the monitoring program. Calibrations are also conducted in the field within one week of a motor breakdown and/or once per month. The calibrations were done with the Kurtz NIST (National Institute of Standards and Technology) traceable mass flow calibrator.

8.1.2 Dichotomous Sampler

The dichotomous sampler is a derivative of the high volume sampler. The sampler aerodynamically separates the particulates into two size fractions: fine (<2.5 microns) and coarse (2.5 to 10 microns). Fine and coarse particulates are collected by drawing a known volume of air through two individual pre-weighed filters for a 24-hour period. The total particulate concentration in the two size ranges may then be calculated for the 24-hour period.

The dichotomous sampler was calibrated with the Gilibrator mass flow calibrator traceable to NIST. Calibrations were conducted in the laboratory prior to field operations and again at the end of the monitoring program.

8.1.3 Total Dustfall Monitor

Total dustfall was measured by a cylinder containing an entrapment liquid (water in the summer; iso-propyl alcohol or gylcol in the winter) which is erected vertically so that the surface of the liquid is level with the horizontal plane. Particles will settle into the

cylinder and onto the surface of the liquid. At the end of the monitoring period (one month), the sample is sent to the laboratory to determine the total dustfall loading contained in the sample.

8.1.4 Wind Instrument

Wind speed and direction were measured by a Windflow 540 wind speed anemometer and wind direction vane. The threshold wind speed attainable by this instrumentation is about 2 km/h. Wind data is recorded once per second by the on-site data acquisition system. The data acquisition system then calculates five-minute and one-hour averages of wind direction and speed.

8.2 WIND DATA

September: Wind Speed (km/h)

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
sep 1	.7	.9	2.7	3.0	3.0	3.6	4.2	4.7	6.7	8.4	4.3	6.4	6.8	6.6	6.2	6.3	6.9	7.6	7.0	7.7	3.6	.1	.8	.2
sep 2	1.7	4.6	6.9	3.7	1.4	4.7	1.1	1.4	8.5	5.9	6.8	5.2	5.7	4.5	.6	2.1	3.2	3.1	5.3	1.3	1.6	10.8	5.3	4.0
sep 3	6.6	4.9	1.8	3.0	3.2	.8	1.0	2.5	6.8	9.5	5.0	6.6	7.9	8.1	6.7	7.2	7.2	6.1	1.0	.0	.0	.0	.0	.0
sep 4	1.6	.5	.1	1.2	1.8	3.9	5.4	5.6	7.7	7.1	7.6	6.3	6.1	6.3	5.0	7.7	5.8	6.6	2.5	.0	.0	.1	1.4	5.4
sep 5	.9	.1	.0	.9	.4	1.8	4.6	3.0	7.9	9.5	9.2	7.5	6.8	10.8	10.7	10.3	14.1	17.4	13.8	6.1	2.2	1.3	.2	.8
sep 6	.1	.8	.9	.1	3.0	2.4	4.6	5.5	12.1	13.2	15.0	9.4	4.4	6.0	8.2	7.0	7.1	5.9	5.5	3.9	3.6	3.0	3.2	3.2
sep 7	2.2	1.6	4.7	5.5	5.2	4.8	5.1	5.7	4.8	6.7	8.2	15.3	21.1	17.8	16.2	16.6	14.7	14.0	11.3	10.4	4.0	3.6	4.4	3.2
sep 8	5.0	6.6	3.1	1.8	5.4	9.0	9.5	7.2	12.2	10.3	9.9	10.7	9.2	7.2	10.4	9.0	6.6	7.2	3.3	2.7	.3	.2	.5	1.6
sep 9	.6	.0	.1	.0	.6	.7	2.1	4.7	6.5	11.2	11.3	9.2	7.3	6.4	5.9	5.6	4.1	4.5	2.0	7.6	4.6	1.3	1.4	.2
sep10	.4	.2	.5	2.9	1.8	2.3	3.1	6.5	11.7	11.9	7.8	3.1	8.1	11.7	11.6	7.3	12.2	8.7	3.3	3.8	7.0	.6	.2	.8
sep11	.0	.1	.0	.5	3.4	.3	.9	4.2	4.1	3.8	5.0	7.3	10.5	10.2	11.3	8.6	9.4	7.8	6.4	7.9	.7	15.3	21.3	20.0
sep12	11.7	5.8	2.1	2.2	1.9	3.1	2.0	.3	8.0	16.3	19.2	8.7	9.0	13.0	20.3	20.0	17.2	13.3	12.2	6.3	1.7	3.3	4.8	1.4
sep13	1.8	.8	3.2	2.3	3.4	5.8	5.8	5.7	7.0	7.9	9.5	11.4	11.0	11.0	8.6	8.0	6.3	5.0	3.5	.0	1.8	2.6	2.8	.9
sep14	1.0	1.8	.9	1.4	.2	.0	.3	1.4	1.8	8.0	9.9	8.9	12.9	10.7	10.8	8.8	7.8	9.0	4.7	4.6	8.3	7.7	8.4	5.5
sep15	6.5	4.3	10.5	11.6	10.6	9.6	7.6	6.4	5.6	9.9	14.1	13.2	13.1	13.2	12.7	12.0	9.8	10.4	5.0	2.8	9.1	6.0	5.8	1.3
sep16	4.5	7.3	4.1	.6	1.6	6.0	7.2	9.1	3.8	4.0	6.5	8.1	7.8	16.5	19.5	21.3	15.7	17.0	21.5	21.1	22.0	22.9	23.5	24.6
sep17	22.7	19.7	16.6	12.0	7.3	7.7	5.0	1.9	4.5	5.9	8.3	9.3	13.1	12.5	12.2	12.2	9.8	6.2	4.2	.4	.5	.4	.0	.3
sep18	.1	.0	.0	.0	.3	2.5	1.5	2.8	4.7	6.4	4.7	5.0	5.2	5.3	5.6	3.6	4.0	4.2	6.2	2.8	.6	1.0	.5	.3
sep19	5.2	14.1	13.4	13.2	9.5	2.8	1.1	1.2	2.4	10.4	13.2	16.2	17.1	19.3	18.0	18.6	15.3	13.4	8.5	2.5	3.6	1.4	2.6	2.9
sep20	6.4	6.1	7.5	10.4	12.2	6.5	2.9	2.4	4.1	5.5	6.9	11.8	12.6	12.3	12.7	12.0	10.8	8.5	3.1	.2	.4	.4	.7	7.5
sep21	12.0	11.1	9.6	8.4	9.8	8.4	8.5	6.6	9.3	9.3	11.9	9.9	10.2	6.9	6.2	4.4	8.7	8.4	6.7	9.2	7.6	6.1	5.0	5.1
sep22	5.0	5.0	5.7	5.9	5.3	4.9	5.0	5.2	6.5	6.3	5.8	6.4	6.5	6.5	6.9	8.1	6.3	5.9	2.5	.0	.0	.0	.9	2.8
sep23	2.9	3.0	4.9	2.9	3.1	6.6	6.2	6.5	5.7	5.7	8.9	13.7	13.3	15.7	15.2	12.0	16.2	14.5	8.0	4.7	4.4	3.2	7.2	5.1
sep24	3.2	4.0	3.3	2.2	.7	1.2	2.9	3.4	3.3	4.2	5.1	7.9	5.1	7.4	8.4	10.5	17.9	14.8	3.8	3.3	2.1	.3	2.2	1.9
sep25	.4	.1	.0	.2	1.8	1.2	.5	.9	3.5	2.5	6.1	11.3	12.6	14.0	14.2	12.6	9.9	8.6	5.7	6.2	8.4	10.4	7.4	4.7
sep26	2.1	.0	1.0	1.9	.3	.2	.5	.4	1.5	2.6	2.1	2.8	.5	5.0	4.0	6.0	7.7	6.1	4.3	2.1	2.6	1.2	.0	.0
sep27	.6	.2	.0	.0	1.4	2.6	2.3	2.4	4.8	7.8	6.6	4.3	9.8	8.6	5.9	6.3	6.7	4.3	1.5	.7	.8	.0	.1	1.4
sep28	2.6	.0	.0	.2	1.2	4.5	4.3	6.1	11.9	16.7	21.1	21.7	21.8	21.8	21.5	22.5	18.1	12.4	10.8	10.2	6.1	4.1	2.0	4.0
sep29	6.2	7.3	8.8	3.0	6.3	17.2	13.1	4.8	7.0	14.3	18.9	21.7	16.8	10.7	9.9	13.3	10.9	7.6	2.1	2.1	1.4	.5	.9	.6
sep30	1.2	3.1	3.8	2.9	3.7	3.4	2.6	3.7	7.0	8.0	7.4	13.2	15.9	14.9	13.2	11.4	10.1	8.5	3.2	.9	.3	1.7	1.8	.2

September: Wind Direction

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
sep 1	s	s	s	s	s	ssw	ssw	s	ssw	ssw	s	s	s	s	s	sse	sse	se	se	se	sse	sse	sse	ssw
sep 2	s	wnw	nw	nw	wnw	nw	wnw	wnw	wnw	nw	nw	wnw	nnw	nne	n	w	sw	sw	s	sse	sse	wnw	sse	ssw
sep 3	nw	nw	w	ssw	s	ssw	ssw	wnw	w	wnw	wnw	w	w	w	w	sw	wnw	wnw	ssw	calm	calm	calm	calm	calm
sep 4	s	s	sse	s	s	ssw	ssw	s	ssw	ssw	ssw	s	s	ssw	ssw	s	sse	s	sse	calm	calm	wnw	nnw	nw
sep 5	nw	w	calm	sse	nne	s	s	s	s	s	s	ssw	nw	nne	n	nne	nne	nne	nne	n	nw	nw	nw	nw
sep 6	n	sse	sse	sse	s	s	s	ssw	ssw	sw	ssw	ssw	w	wsw	w	sw	sw	s	s	s	s	s	s	sse
sep 7	sse	s	s	s	sse	sse	sse	sse	s	ssw	w	wnw	wnw	wnw	nw	nw	nnw	n	n	nnw	nw	nw	n	nw
sep 8	nne	ene	se	ne	nne	nne	nne	ne	n	n	n	nnw	nnw	nnw	n	nne	ne	ne	ene	ese	sse	wsw	ssw	s
sep 9	sse	calm	sse	calm	sw	sse	sse	s	s	s	s	s	ssw	ssw	w	w	w	sw	s	nne	ne	nw	nnw	nne
sep10	w	s	s	sse	s	s	s	s	ssw	ssw	s	sw	w	w	wnw	w	wnw	wnw	wnw	n	nne	sse	wsw	nw
sep11	calm	nnw	calm	ssw	s	s	s	s	s	sse	s	sse	se	se	se	sse	ese	ese	e	e	ne	n	n	nne
sep12	nne	n	sse	s	sw	s	se	se	nw	nw	nw	w	w	wnw	nw	nw	nw	nw	nw	nw	wnw	wnw	wnw	wnw
sep13	w	ssw	s	s	s	s	s	s	ssw	ssw	ssw	ssw	sw	wsw	wsw	wsw	sw	sw	ssw	calm	s	s	ssw	s
sep14	nw	nw	ssw	ssw	sse	calm	sse	sse	wsw	wnw	nw	wnw	nw	nnw	nnw	nnw	nne	nne	ene	e	e	ese	se	se
sep15	se	sse	se	se	se	ese	e	e	e	sse	s	s	s	s	sse	sse	sse	sse	se	ese	se	se	se	n
sep16	e	e	ene	ese	w	wsw	wnw	ese	ese	se	nw	n	nnw	sw	ssw	w	sw	wsw	w	w	w	w	w	w
sep17	wnw	w	w	wnw	nw	nw	wnw	wnw	w	w	wnw	wnw	wnw	nw	nw	nw	nnw	nnw	nne	e	nw	nnw	calm	nw
sep18	nnw	calm	calm	calm	sw	ssw	ssw	s	ssw	ssw	s	sse	sse	s	se	se	e	ne	nne	nne	nw	nw	nw	nw
sep19	nw	nnw	nnw	nw	nw	wnw	ssw	ssw	wsw	wnw	nw	nw	nw	wnw	nw	nw	nnw	nnw	nw	nw	nw	nw	nw	wnw
sep20	w	wnw	wnw	w	w	wnw	wnw	sw	s	wnw	wnw	wnw	wnw	wnw	wnw	wnw	wnw	wnw	wnw	w	wnw	wnw	wnw	wnw
sep21	nw	wnw	wnw	nw	nw	nw	wnw	nw	nw	nw	nnw	nnw	nnw	nw	nnw	nne	e	e	e	se	sse	s	s	s
sep22	s	s	s	s	s	ssw	s	ssw	s	ssw	ssw	s	sse	sse	sse	s	s	se	se	calm	calm	calm	calm	sse
sep23	s	s	s	sse	s	s	s	s	sse	ssw	wsw	wnw	wnw	wnw	w	w	w	wnw	w	w	wnw	wnw	wnw	wnw
sep24	s	s	s	s	se	s	sse	sse	s	ssw	ssw	sw	sw	wsw	w	w	w	wnw	wnw	nw	nnw	sw	nnw	n
sep25	se	sse	calm	w	ssw	s	s	sse	s	ssw	w	nw	n	n	nnw	nnw	nnw	nnw	n	nne	nnw	nnw	nnw	nw
sep26	nnw	calm	nnw	nnw	nnw	nnw	w	sw	sw	wnw	e	n	w	ene	se	e	ne	ne	nne	nne	nnw	nw	calm	calm
sep27	nw	nw	calm	calm	nnw	nw	nw	nw	wnw	nw	nnw	n	n	n	nnw	nnw	nnw	nw	nnw	nnw	nnw	calm	n	ne
sep28	e	calm	calm	se	se	se	se	ese	se	sse	sse	sse	sse	sse	sse	sse	sse	sse	sse	sse	se	sse	sse	s
sep29	s	s	s	sw	nw	n	nnw	nw	nw	nw	nnw	nw	wnw	w	sw	ssw	sw	sw	sw	sse	sse	e	sse	s
sep30	s	s	s	sse	sse	sse	s	s	ssw	ssw	w	wnw	wnw	wnw	wnw	nw	nnw	n	n	nw	wnw	nw	nw	nnw

October: Wind Speed (km/h)

HOUR

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oct 1	.7	.6	.4	.0	4.4	9.5	12.7	15.2	20.8	24.3	22.4	20.0	16.4	4.3	2.8	.4	6.8	5.9	1.2	1.3	1.3	.0	5.6	10.9
oct 2	7.7	6.1	5.5	9.9	15.8	20.5	14.4	7.1	5.0	12.4	24.7	25.1	24.1	25.0	21.9	24.7	23.1	17.5	6.5	3.2	2.2	4.1	9.9	11.6
oct 3	10.9	11.4	8.6	5.7	5.6	4.4	7.9	8.9	13.7	19.8	22.0	20.9	16.5	17.3	14.0	13.6	11.7	8.8	7.0	2.8	2.1	1.0	.0	1.5
oct 4	4.9	7.1	8.5	6.5	2.5	4.1	5.8	6.8	8.6	7.2	6.1	8.0	9.2	9.8	10.7	11.3	10.6	8.7	8.8	4.9	5.9	4.6	5.2	4.8
oct 5	4.0	1.7	4.5	4.0	1.3	1.0	.3	1.6	2.4	2.7	.8	6.0	6.8	6.7	4.8	6.5	3.6	2.7	1.5	.7	.0	.0	.0	.0
oct 6	.0	.0	.0	.0	1.6	1.3	1.3	.6	1.5	3.0	6.2	3.1	4.3	7.2	4.5	4.2	2.7	.4	.0	.3	.0	.0	2.8	.9
oct 7	.6	1.3	2.2	3.0	3.1	3.5	4.0	3.3	2.9	6.1	6.2	7.8	9.0	8.4	5.2	3.9	5.7	8.6	5.3	4.6	5.0	7.4	6.4	5.4
oct 8	2.8	.3	1.5	.8	.6	.3	1.5	5.1	5.3	9.6	9.5	9.2	6.9	7.8	6.9	4.8	1.4	3.0	4.7	4.0	4.0	3.4	6.1	4.3
oct 9	3.9	4.0	3.2	.6	2.4	3.7	3.2	3.6	4.6	5.3	5.5	5.4	6.3	1.5	.8	.1	.6	1.7	1.9	8.2	24.6	15.9	10.4	11.7
oct10	18.7	17.7	20.6	17.6	19.8	18.3	17.5	14.9	14.7	18.7	19.8	15.9	19.5	20.6	20.7	17.8	16.8	7.4	4.0	12.9	15.2	12.1	12.2	12.6
oct11	11.8	11.9	13.0	11.7	13.0	5.7	2.1	.0	.5	1.8	3.7	5.8	7.5	10.5	13.1	13.3	13.8	14.8	10.0	7.6	7.6	6.9	6.3	1.3
oct12	1.2	.8	.9	1.7	1.6	5.4	.6	2.4	3.4	5.0	9.5	15.6	16.2	18.3	18.0	24.0	15.8	14.1	9.5	6.7	4.7	5.9	5.5	4.1
oct13	5.5	5.0	4.3	3.6	3.9	3.5	3.6	3.2	6.0	10.6	15.3	16.5	23.0	21.8	21.1	17.4	19.6	18.3	10.6	8.0	8.1	7.6	8.6	8.3
oct14	8.6	5.7	8.0	8.8	8.1	9.0	5.3	4.8	6.3	10.3	15.2	17.5	16.9	18.6	18.4	15.4	11.2	2.3	.0	.2	1.5	5.4	6.1	3.2
oct15	2.4	.7	.5	.9	.3	.1	.3	3.3	3.9	5.4	6.8	7.2	5.8	5.9	4.8	7.5	5.0	5.3	3.9	2.0	.3	1.4	2.0	.6
oct16	1.0	3.5	1.5	.8	1.4	1.4	2.9	1.7	.6	2.6	5.7	7.5	11.1	12.6	9.8	12.1	13.7	8.0	7.4	5.0	6.7	2.3	3.7	1.5
oct17	.2	.4	.0	.0	.0	1.9	5.0	1.4	2.1	3.3	4.9	6.3	8.5	12.6	12.0	14.7	14.9	11.3	11.7	10.8	7.9	6.1	5.7	3.5
oct18	5.9	3.2	3.9	2.9	3.2	3.6	3.5	4.0	4.5	8.9	7.7	9.3	7.5	8.3	10.5	9.3	5.8	6.1	3.9	2.4	2.5	2.4	3.2	6.0
oct19	11.9	16.0	8.4	4.5	4.2	5.2	2.3	4.8	4.3	16.4	17.7	22.1	27.8	25.3	19.9	18.0	12.2	9.0	7.1	1.6	.6	.5	1.2	.1
oct20	2.6	3.0	3.7	7.1	7.2	7.9	5.4	4.1	4.3	5.0	5.5	4.5	5.8	6.8	7.6	6.4	4.4	2.3	.9	1.9	1.7	2.8	.1	1.8
oct21	1.5	1.6	3.4	3.9	1.8	1.0	1.8	1.5	.6	3.0	3.6	3.5	8.1	11.4	28.8	28.2	17.9	12.6	7.0	5.9	8.1	6.0	4.1	5.1
oct22	3.7	2.0	1.4	2.7	3.3	2.1	2.0	3.4	7.8	10.3	14.1	22.1	28.4	24.5	19.9	16.6	16.7	8.7	4.7	7.7	8.7	7.3	1.6	1.8
oct23	1.2	1.0	2.3	4.5	4.7	4.1	3.0	1.5	2.3	5.8	6.8	7.2	8.3	8.1	8.2	7.5	6.3	7.8	8.9	7.7	6.8	4.5	.8	.4
oct24	2.3	4.0	3.9	8.1	5.2	5.8	5.2	3.2	3.4	4.6	6.1	8.9	9.1	9.9	11.7	9.3	4.8	4.1	.9	4.5	7.8	4.9	2.3	5.3
oct25	3.6	2.1	1.2	1.5	1.3	1.2	1.5	4.1	1.1	2.7	.4	3.0	5.8	8.0	11.1	7.6	4.7	3.7	3.0	1.7	.6	.2	8.7	10.7
oct26	4.4	1.0	1.0	.4	2.4	9.3	3.1	2.6	6.2	9.0	12.6	16.5	27.4	25.3	22.2	21.6	12.2	9.7	3.6	.1	.5	.6	.0	.0
oct27	.7	4.8	5.9	9.7	8.5	8.0	11.2	8.7	6.4	5.1	3.9	5.1	5.6	5.7	9.0	6.8	4.6	2.3	.5	.7	2.2	5.8	.7	5.0
oct28	3.2	2.0	.7	.6	.8	7.3	8.0	24.3	17.5	16.1	16.4	19.5	25.7	32.6	30.9	24.3	15.6	8.4	3.4	.4	2.0	1.3	.5	1.4
oct29	.4	.5	.8	.7	1.2	3.8	6.2	7.5	7.4	7.8	8.4	7.7	2.3	3.4	4.9	5.2	7.7	8.4	11.0	11.1	10.4	11.2	9.5	11.3
oct30	5.9	6.8	3.8	.5	1.4	1.1	3.3	1.9	1.9	4.3	8.1	7.7	11.8	8.5	1.3	2.3	1.4	1.3	2.0	.7	1.9	1.6	1.2	2.1
oct31	7.2	7.2	7.2	7.2	3.6	.0	3.6	3.2	.0	3.6	7.2	10.8	10.8	7.2	7.2	3.6	3.6	7.2	7.2	7.2	7.2	7.2	7.2	7.2

October: Wind Direction

HOUR

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oct 1	nnw	nw	nnw	calm	se	ese	ese	ese	se	se	ese	ese	ese	s	se	wsw	n	sse	n	nnw	nnw	calm	w	w
oct 2	wnw	nw	nw	wnw	nw	nw	nw	wnw	wnw	wnw	nw	nw	nw	wnw	wnw	nw	wnw	nw	nw	wnw	w	w	wnw	wnw
oct 3	wnw	wnw	w	w	w	w	w	wnw	w	nw	wnw	wnw	nw	wnw	nw	nnw	n	nne	ne	ne	ne	se	calm	ene
oct 4	ne	e	ese	se	ese	se	ese	e	e	e	e	e	e	e	e	e	e	e	e	e	ene	ne	ne	ne
oct 5	ne	nne	nne	nne	n	n	n	n	n	n	nnw	nnw	n	nnw	nnw	nne	nne	n	nnw	nw	calm	calm	calm	calm
oct 6	calm	calm	calm	calm	sse	se	sse	s	sse	ssw	sw	sw	wsw	wnw	nw	wsw	wsw	wnw	calm	nw	calm	calm	ssw	s
oct 7	sse	sse	sse	s	sse	s	sse	s	s	s	ssw	ssw	ssw	ssw	ssw	sw	wnw	wnw	w	wsw	w	w	w	wnw
oct 8	wnw	nw	sw	ssw	ssw	s	s	s	s	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	s
oct 9	sse	s	sw	s	s	sse	sse	sse	s	s	s	s	ssw	sw	w	w	wnw	ssw	s	nw	nw	wnw	wnw	wnw
oct10	wnw	wnw	wnw	wnw	wnw	wnw	wnw	w	wnw	wnw	wnw	nw	nw	nw	nw	nw	nw	nnw	nnw	wnw	nw	nw	nw	nw
oct11	nw	nw	nw	wnw	nw	wnw	nw	calm	nnw	sse	s	s	sse	sse	sse	sse	se	se	ese	e	ese	se	sse	ssw
oct12	ese	sw	nnw	w	w	nw	wnw	s	s	wsw	w	wnw	w	wnw	w	w	w	w	w	w	wsw	wsw	sw	wsw
oct13	s	ssw	sw	sw	wsw	wsw	w	wnw	w	w	w	w	wnw	wnw	wnw	wnw	w	wnw	wnw	w	w	w	w	w
oct14	w	w	w	w	w	wnw	w	w	wnw	wnw	wnw	nw	wnw	wnw	wnw	wnw	wnw	w	calm	nw	nw	wnw	nw	wnw
oct15	wnw	nw	wnw	nw	w	wsw	wnw	s	s	sw	wsw	wsw	w	w	nw	n	ne	ne	ene	nne	se	ne	n	n
oct16	n	ne	nnw	se	ne	n	ssw	s	wnw	wsw	wsw	wsw	wsw	ssw	sw	ssw	s	s	sse	s	w	wnw	ssw	sse
oct17	s	sse	calm	calm	calm	s	s	s	s	s	sse	sse	sse	se	sse	sse	se	ese	ese	se	se	se	se	sse
oct18	s	s	ssw	ssw	s	s	s	s	ssw	ssw	ssw	ssw	sw	sw	sw	sw	wsw	wnw	wnw	w	w	w	nnw	nw
oct19	nnw	nw	nw	sw	w	wnw	sw	s	wsw	wnw	nw	nw	nw	nw	nw	nw	nnw	nnw	nnw	nw	wnw	wnw	nw	w
oct20	s	sse	ssw	ssw	ssw	ssw	ssw	sse	s	sse	sse	w	w	wnw	wnw	wnw	sw	s	ssw	s	s	sse	sse	sse
oct21	s	s	sse	ssw	s	ssw	sse	e	sse	s	ssw	ssw	wnw	wnw	wnw	wnw	wnw	wnw	w	w	wnw	w	w	w
oct22	w	wnw	ssw	s	sse	sse	sw	wsw	wsw	wsw	w	w	wnw	wnw	wsw	w	w	wnw	w	w	wnw	wnw	wnw	s
oct23	w	ssw	sse	sse	s	s	sse	s	s	s	s	ssw	ssw	s	ssw	ssw	sse	se	se	sse	sse	sse	sse	sse
oct24	sse	s	s	ssw	s	s	ssw	s	s	s	ssw	sw	sw	ssw	sw	wsw	n	n	nnw	nnw	nnw	nne	ne	ne
oct25	ne	ene	nne	nnw	nnw	n	ne	ene	e	ne	s	nne	ne	n	nne	nne	nne	nne	ne	nne	nnw	se	nw	nw
oct26	nnw	sw	nw	nw	nnw	wnw	ssw	sw	wsw	w	w	wnw	wnw	nw	nw	nw	nnw	n	ne	ese	ne	ene	calm	calm
oct27	sse	sse	se	se	sse	sse	se	se	se	se	ene	ene	ene	ene	ne	nne	nne	n	n	wnw	s	sse	ssw	s
oct28	s	sse	nw	nnw	sse	s	nw	wnw	wnw	wnw	wnw	wnw	wnw	w	w	w	w	w	wsw	sw	ssw	s	s	s
oct29	ssw	sw	ssw	ene	nw	nw	nw	wnw	wnw	wnw	wnw	nw	wnw	wnw	s	se	sse	sse	sse	sse	e	sse	se	se
oct30	sse	ene	e	ene	se	s	sse	s	ssw	sw	wnw	wnw	wnw	wnw	sw	s	ne	ene	e	ene	nne	nnw	nnw	nnw
oct31	wnw	wnw	wnw	wnw	wnw	calm	wsw	wnw	calm	w	wnw	wnw	wnw	wnw	wnw	wnw	ssw	sw	sw	w	wnw	wnw	wnw	wnw

November: Wind Speed (km/h)

DATE	HOUR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
nov 1	7.2	7.2	10.8	10.8	10.8	10.8	7.2	10.8	14.4	14.4	18.0	18.0	18.0	18.0	14.4	14.4	10.8	7.2	7.2	7.2	7.2	7.2	10.8	7.2
nov 2	7.2	7.2	7.2	7.2	7.2	7.2	3.6	3.6	3.6	7.2	10.8	10.8	7.2	7.2	3.6	3.6	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
nov 3	7.2	7.2	3.6	.0	.0	.0	.0	.0	3.6	7.2	14.4	21.6	21.6	21.6	18.0	14.4	14.4	10.8	7.2	7.2	.0	3.6	.0	3.6
nov 4	3.6	3.6	3.6	3.6	3.6	3.6	3.6	7.2	10.8	10.8	14.4	18.0	18.0	18.0	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
nov 5	7.2	10.8	7.2	7.2	7.2	7.2	10.8	7.2	7.2	10.8	10.8	14.4	14.4	14.4	14.4	14.4	10.8	10.8	7.2	7.2	7.2	7.2	3.6	3.6
nov 6	2.3	1.8	4.9	6.3	5.0	2.1	1.4	.3	.0	2.3	4.3	10.1	12.0	10.5	8.1	5.7	2.5	5.8	6.8	6.8	4.5	3.6	5.1	4.6
nov 7	5.0	6.1	5.8	3.8	7.5	9.7	9.4	8.5	9.5	9.4	10.4	14.4	19.3	19.7	19.5	19.5	9.4	6.9	6.6	5.9	8.0	8.1	9.9	8.0
nov 8	6.8	7.8	12.3	13.5	16.6	13.1	10.6	5.4	6.2	6.5	17.0	16.5	21.7	17.4	14.2	12.0	6.2	4.7	10.2	6.5	3.9	2.4	.7	1.8
nov 9	6.0	4.0	5.1	6.1	8.3	9.1	8.0	7.7	8.1	9.6	12.7	11.9	9.8	9.4	8.8	11.1	9.9	7.1	6.4	2.1	2.3	3.8	4.3	4.8
nov10	9.0	9.3	8.9	8.7	4.8	4.6	4.3	4.1	3.5	4.9	5.7	7.9	9.8	10.4	11.8	14.1	13.3	12.7	13.8	14.4	15.1	13.5	16.2	13.6
nov11	15.3	12.2	14.2	15.4	13.4	11.3	10.1	9.1	11.0	10.9	9.0	9.9	9.3	10.4	12.1	9.2	10.8	10.3	11.7	9.5	8.3	8.8	5.4	5.1
nov12	6.0	6.1	4.0	3.8	3.8	3.8	4.8	4.3	5.8	4.8	5.5	4.9	3.3	5.5	4.4	4.7	5.9	3.1	2.7	2.6	2.1	1.9	1.6	2.4
nov13	.5	1.1	1.0	.5	2.6	2.7	2.8	1.0	2.6	1.9	2.3	.9	6.2	10.9	15.9	11.6	6.6	3.8	7.0	7.1	4.0	9.0	6.6	9.0
nov14	6.9	6.9	7.9	10.8	9.7	5.3	.3	2.4	4.1	3.0	5.6	6.5	5.9	6.4	5.9	3.2	.8	1.5	.1	.2	.5	2.3	2.3	.3
nov15	2.0	3.1	1.3	3.3	2.5	1.3	.5	.2	.2	2.4	4.3	4.2	4.7	3.5	3.5	1.2	1.6	.0	.2	1.4	7.0	6.9	7.2	5.4
nov16	5.6	4.4	1.8	3.3	3.6	3.2	4.4	3.5	4.8	5.4	8.6	6.3	6.7	4.7	5.9	2.2	.1	.0	.0	.0	1.7	1.1	.1	5.2
nov17	11.1	10.7	9.8	3.3	6.4	8.7	11.1	12.6	13.1	8.6	7.3	5.4	5.0	5.4	5.0	4.7	4.5	.6	.2	.1	3.4	2.7	2.3	5.2
nov18	4.9	4.4	3.6	1.4	2.1	2.5	2.5	3.6	3.7	4.9	7.9	7.7	7.8	5.3	4.1	4.0	.9	1.2	1.7	5.5	5.6	3.5	4.6	6.1
nov19	6.3	5.1	3.8	3.3	.1	.4	1.2	.0	.2	.0	.5	.4	.7	1.0	8.9	7.3	8.1	9.0	4.7	6.7	10.4	10.2	11.9	14.1
nov20	12.2	10.8	12.3	8.7	8.6	8.5	8.0	7.6	7.4	7.4	6.4	5.9	8.5	7.7	9.3	6.4	6.7	6.2	6.9	7.1	10.8	11.7	9.0	8.3
nov21	8.1	4.5	1.3	2.3	.0	.1	.0	.2	.1	1.8	5.1	.6	.3	.0	.4	.0	.0	.0	.0	.9	.5	.0	.1	.2
nov22	5.9	11.0	12.3	11.8	5.7	4.8	4.1	5.9	5.4	5.3	5.1	4.1	7.9	10.1	4.9	.2	2.5	2.9	1.3	6.5	5.3	4.1	3.9	3.3
nov23	5.0	5.0	5.9	6.6	8.6	8.0	6.7	6.9	8.5	5.5	6.2	6.3	8.8	14.7	12.1	12.8	13.0	12.0	13.4	14.3	11.3	9.3	9.9	7.8
nov24	4.6	1.2	6.2	9.7	3.7	2.0	.2	.0	3.0	.6	5.5	2.5	6.8	5.9	4.3	5.4	5.5	1.7	2.2	.3	1.3	.0	.0	.7
nov25	.2	.0	.0	.0	.2	.0	.0	.2	.0	.0	.9	2.7	2.8	4.9	3.9	4.2	1.4	.3	.0	.5	.1	.1	.0	.0
nov26	.0	.0	.3	.0	.0	.0	.0	.0	.0	.0	6.1	8.1	8.5	8.2	9.8	7.2	7.6	4.0	1.5	.0	.0	.0	.0	2.8
nov27	4.4	2.5	2.6	2.6	2.7	1.3	2.0	2.9	3.2	3.5	4.3	1.3	1.2	3.3	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0
nov28	.0	.0	.0	.0	.0	.0	.1	.0	.5	1.6	.2	3.9	7.4	9.0	11.6	13.3	12.1	8.1	9.3	5.8	7.8	6.5	6.0	4.5
nov29	2.4	7.5	8.6	21.7	18.4	9.7	9.5	11.9	10.1	11.3	18.0	22.6	16.3	24.9	19.5	16.7	19.3	17.0	10.3	15.1	10.7	5.6	5.8	.3

November: Wind Direction

DATE	HOUR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
nov 1	nw	nw	nw	nw	nw	nw	nw	nw	nw	nw	nw	nw	nw	nw	nnw	nw	nw	nw	nw	wnw	wnw	wnw	wnw	wnw
nov 2	wnw	w	w	nw	wnw	wnw	w	wnw	w	w	w	w	wnw	nw	nw	ene	se	sse	s	ssw	ssw	s	s	s
nov 3	s	sse	sse	calm	calm	calm	calm	calm	se	se	se	sse	sse	sse	se	se	sse	se	sse	sse	calm	s	calm	ssw
nov 4	sw	w	wnw	wnw	wsw	w	wnw	wnw	wnw	nw	nw	nw	nw	nw	nnw	nw	nw	nw	nnw	nnw	nw	nw	nw	nw
nov 5	nw	wnw	wnw	nw	wnw	wnw	wnw	wnw	wnw	wnw	wnw	wnw	nw	nw	wnw	nw	nw	wnw	wnw	w	wsw	sw	sw	w
nov 6	nnw	nnw	nnw	nw	nnw	nw	ssw	wsw	calm	ssw	wnw	s	ssw	s	s	sse	s	s	ssw	s	ssw	wsw	w	w
nov 7	wsw	wnw	w	w	sw	wsw	wsw	wsw	wsw	wsw	wsw	w	w	w	w	w	w	w	wsw	wsw	wsw	wsw	sw	sw
nov 8	sw	sw	nnw	nnw	nw	nw	wnw	w	w	w	nw	wnw	nw	wnw	wnw	wnw	w	w	w	w	wnw	nw	nnw	ssw
nov 9	s	s	s	s	s	sse	sse	s	s	s	s	sse	s	sse	sse	se	se	se	sse	sse	sse	nnw	n	nw
nov10	nnw	nw	nw	nnw	nw	nw	nw	n	ne	nne	ene	e	ene	ene	e	e	ene	e	ene	ene	ene	ene	e	ene
nov11	ene	ene	e	e	e	e	e	e	e	ese	ese	e	e	e	ene	ene	ene	ene	ene	ene	ene	ene	ne	nne
nov12	n	n	ne	nne	ne	ne	ene	e	e	e	e	e	e	ne	ene	nne	nne	nne	n	nw	nw	nw	nw	nw
nov13	nw	nw	nnw	ne	nne	nne	nnw	nne	sse	s	s	ssw	nw	nnw	nnw	nw	wnw	w	w	wsw	sw	ssw	sw	sw
nov14	ssw	ssw	ssw	ssw	s	s	w	s	sse	s	ssw	ssw	ssw	sw	ssw	s	ssw	ssw	s	wnw	sw	ssw	s	s
nov15	s	sse	n	s	s	sse	ssw	w	nw	s	s	s	ssw	ssw	ssw	ssw	s	calm	s	s	s	ssw	ssw	ssw
nov16	ssw	ssw	ssw	ssw	ssw	sw	ssw	ssw	s	ssw	ssw	ssw	sw	sw	wsw	ssw	ssw	calm	calm	calm	sse	ne	nnw	nnw
nov17	nw	nw	nw	nw	nw	w	w	w	wnw	wnw	w	wsw	wsw	sw	sw	sw	sw	ssw	s	sw	w	w	wsw	sw
nov18	ssw	ssw	s	s	s	s	s	s	s	s	s	ssw	ssw	s	s	ssw	s	s	ssw	ssw	ssw	ssw	s	ssw
nov19	ssw	ssw	ssw	s	s	s	nne	calm	n	calm	ene	wsw	sw	n	nne	nne	nne	ne	nne	nne	nne	nne	nne	n
nov20	n	n	nnw	nnw	nnw	n	nnw	nnw	nnw	nnw	n	nnw	nnw	nnw	nnw	nw	nw	nw	nw	nw	nw	nw	nw	wnw
nov21	wnw	wnw	wsw	wsw	calm	wnw	calm	w	wsw	s	s	s	s	calm	ene	calm	calm	calm	calm	ene	ene	calm	ene	ene
nov22	ne	ne	ne	ene	ne	n	nnw	nnw	nnw	nw	wnw	wnw	nw	nnw	nw	nw	ne	n	nw	nnw	n	nnw	n	nne
nov23	ene	ne	ne	nne	ne	ne	ne	ne	ene	ene	ene	ene	ene	ene	ene	ene	ene	ne	nne	n	nnw	wnw	nw	nw
nov24	nw	nw	wnw	wnw	nw	nw	nw	calm	ssw	ssw	ssw	s	ssw	sw	s	s	s	s	s	s	calm	calm	s	
nov25	ene	calm	calm	calm	ne	calm	calm	nne	calm	calm	wnw	nnw	n	n	nnw	n	nnw	nnw	calm	nw	wnw	wsw	calm	calm
nov26	calm	calm	sw	calm	calm	calm	calm	calm	calm	calm	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	s	calm	calm	calm	calm	ssw
nov27	s	s	ssw	ssw	wsw	ssw	s	ssw	s	s	se	sse	w	s	s	calm	calm	calm	calm	calm	calm	calm	calm	calm
nov28	calm	calm	calm	calm	calm	calm	s	calm	s	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	ssw	s	ssw	ssw	s	s
nov29	ssw	ssw	ssw	ssw	ssw	s	s	ssw	ssw	sw	sw	sw	wsw	nw	nw	nw	nw	nw	nw	nw	w	sw	wsw	n

8.3 SUSPENDED PARTICULATE DATA

SITE #1

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
01-Sep-90	19.42	*	*
02-Sep-90	11.08	*	*
03-Sep-90	37.27	*	*
04-Sep-90	87.06	*	*
05-Sep-90	66.70	*	*
06-Sep-90	57.36	*	*
07-Sep-90	159.17	7.55	0.034
08-Sep-90	123.18	16.26	0.047
09-Sep-90	87.84	*	*
10-Sep-90	126.77	8.55	0.139
11-Sep-90	94.05	*	*
12-Sep-90	41.30	*	*
13-Sep-90	64.47	*	*
14-Sep-90	56.75	*	*
15-Sep-90	81.96	*	*
16-Sep-90	*	*	*
17-Sep-90	33.47	*	*
18-Sep-90	45.84	*	*
19-Sep-90	36.65	*	*
20-Sep-90	47.20	*	*
21-Sep-90	38.71	*	*
22-Sep-90	92.53	*	*
23-Sep-90	75.57	*	*
24-Sep-90	160.71	14.90	0.216
25-Sep-90	102.15	13.50	0.117
26-Sep-90	169.84	7.79	0.315
27-Sep-90	144.54	7.04	0.176
28-Sep-90	107.44	14.04	0.048
29-Sep-90	98.66	*	*
30-Sep-90	124.32	6.76	0.054
01-Oct-90	312.12	11.54	0.110
02-Oct-90	208.45	5.90	0.015
03-Oct-90	93.56	*	*
04-Oct-90	7.50	*	*
05-Oct-90	11.35	*	*
06-Oct-90	16.32	*	*
07-Oct-90	8.90	*	*
08-Oct-90	17.14	*	*
09-Oct-90	56.02	*	*
10-Oct-90	18.10	*	*
11-Oct-90	20.29	*	*
12-Oct-90	25.84	*	*
13-Oct-90	26.74	*	*
14-Oct-90	74.33	*	*
15-Oct-90	112.94	11.32	0.244
16-Oct-90	*	*	*

* no data

SITE #1

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
17-Oct-90	30.30	*	*
18-Oct-90	107.01	15.75	0.104
19-Oct-90	98.51	*	*
20-Oct-90	62.19	*	*
21-Oct-90	118.64	6.36	0.009
22-Oct-90	102.54	23.96	0.000
23-Oct-90	69.18	*	*
24-Oct-90	165.90	13.36	0.301
25-Oct-90	112.19	10.13	0.254
26-Oct-90	101.56	7.01	0.307
27-Oct-90	109.68	7.77	0.248
28-Oct-90	101.23	6.43	0.193
29-Oct-90	53.57	*	*
30-Oct-90	247.12	5.16	0.417
31-Oct-90	*	*	*
01-Nov-90	*	*	*
02-Nov-90	*	*	*
03-Nov-90	*	*	*
04-Nov-90	*	*	*
05-Nov-90	*	*	*
06-Nov-90	67.97	*	*
07-Nov-90	102.32	11.06	0.032
08-Nov-90	21.73	*	*
09-Nov-90	22.74	*	*
10-Nov-90	31.01	*	*
11-Nov-90	90.68	*	*
12-Nov-90	31.36	*	1.570
13-Nov-90	26.86	*	*
14-Nov-90	36.56	*	1.310
15-Nov-90	28.83	*	0.617
16-Nov-90	42.88	*	0.574
17-Nov-90	22.01	*	0.179
18-Nov-90	24.87	*	0.491
19-Nov-90	35.03	*	0.213
20-Nov-90	19.58	*	0.901
21-Nov-90	21.01	*	0.437
22-Nov-90	22.16	*	*
23-Nov-90	25.20	*	*
24-Nov-90	27.04	*	1.082
25-Nov-90	19.49	*	0.823
26-Nov-90	21.68	*	0.316
27-Nov-90	28.91	*	1.625
28-Nov-90	26.40	*	*
29-Nov-90	20.89	*	*

* no data

SITE #2

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
01-Sep-90	39.49	*	*
02-Sep-90	18.26	*	*
03-Sep-90	25.42	*	*
04-Sep-90	57.21	*	*
05-Sep-90	65.18	*	*
06-Sep-90	53.68	*	*
07-Sep-90	111.75	11.69	0.132
08-Sep-90	67.65	*	*
09-Sep-90	61.39	*	*
10-Sep-90	100.41	10.61	0.091
11-Sep-90	162.11	10.93	0.067
12-Sep-90	50.97	*	*
13-Sep-90	54.44	*	*
14-Sep-90	86.57	*	*
15-Sep-90	132.96	16.24	0.046
16-Sep-90	28.43	*	*
17-Sep-90	22.44	*	*
18-Sep-90	38.17	*	*
19-Sep-90	23.45	*	*
20-Sep-90	41.97	*	*
21-Sep-90	47.37	*	*
22-Sep-90	53.17	*	*
23-Sep-90	55.07	*	*
24-Sep-90	92.43	*	*
25-Sep-90	84.37	*	*
26-Sep-90	135.83	8.60	0.485
27-Sep-90	122.58	11.63	0.133
28-Sep-90	*	9.43	0.069
29-Sep-90	99.32	*	*
30-Sep-90	79.90	*	*
01-Oct-90	*	15.58	0.345
02-Oct-90	*	*	*
03-Oct-90	96.49	*	*
04-Oct-90	12.26	*	*
05-Oct-90	16.28	*	*
06-Oct-90	19.06	*	*
07-Oct-90	15.92	*	*
08-Oct-90	18.08	*	*
09-Oct-90	96.34	*	*
10-Oct-90	32.38	*	*
11-Oct-90	50.58	*	*
12-Oct-90	32.89	*	*
13-Oct-90	45.24	*	*
14-Oct-90	55.05	*	*
15-Oct-90	87.83	*	*
16-Oct-90	*	*	*

* no data

SITE #2

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
17-Oct-90	90.91	*	*
18-Oct-90	67.90	*	*
19-Oct-90	143.01	19.59	1.047
20-Oct-90	72.12	*	*
21-Oct-90	96.31	*	*
22-Oct-90	100.05	29.08	0.227
23-Oct-90	133.64	7.96	0.073
24-Oct-90	207.05	18.03	0.390
25-Oct-90	*	13.79	0.423
26-Oct-90	130.72	10.47	0.481
27-Oct-90	*	14.40	0.290
28-Oct-90	125.70	14.06	0.658
29-Oct-90	163.85	5.38	0.176
30-Oct-90	*	11.83	0.633
31-Oct-90	145.91	5.55	0.257
01-Nov-90	113.84	9.43	0.539
02-Nov-90	101.61	10.55	0.180
03-Nov-90	72.84	*	0.206
04-Nov-90	*	*	*
05-Nov-90	81.95	*	0.274
06-Nov-90	110.64	15.49	0.268
07-Nov-90	91.80	*	*
08-Nov-90	28.23	*	*
09-Nov-90	30.83	*	0.179
10-Nov-90	67.63	*	*
11-Nov-90	33.59	*	0.244
12-Nov-90	33.06	*	1.974
13-Nov-90	28.59	*	0.399
14-Nov-90	21.39	*	0.214
15-Nov-90	18.66	*	0.324
16-Nov-90	64.88	*	0.285
17-Nov-90	16.05	*	0.230
18-Nov-90	21.47	*	*
19-Nov-90	47.66	*	0.286
20-Nov-90	31.28	*	0.513
21-Nov-90	24.99	*	*
22-Nov-90	27.12	*	*
23-Nov-90	39.36	*	*
24-Nov-90	30.25	*	*
25-Nov-90	*	*	*
26-Nov-90	*	*	*
27-Nov-90	16.65	*	*
28-Nov-90	14.04	*	*
29-Nov-90	20.77	*	*

* no data

SITE #3

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
01-Sep-90	32.62	*	*
02-Sep-90	19.28	*	*
03-Sep-90	23.53	*	*
04-Sep-90	78.43	*	*
05-Sep-90	45.72	*	*
06-Sep-90	99.49	*	*
07-Sep-90	141.07	14.71	0.039
08-Sep-90	*	*	*
09-Sep-90	94.37	*	*
10-Sep-90	102.41	15.49	0.126
11-Sep-90	100.77	15.52	0.046
12-Sep-90	62.66	*	*
13-Sep-90	74.12	*	*
14-Sep-90	74.57	*	*
15-Sep-90	83.63	*	*
16-Sep-90	29.31	*	*
17-Sep-90	38.14	*	*
18-Sep-90	48.15	*	*
19-Sep-90	37.42	*	*
20-Sep-90	63.89	*	*
21-Sep-90	63.76	*	*
22-Sep-90	85.20	*	*
23-Sep-90	69.95	*	*
24-Sep-90	112.58	14.60	0.006
25-Sep-90	77.07	*	*
26-Sep-90	122.35	9.00	0.293
27-Sep-90	99.09	*	*
28-Sep-90	172.14	17.07	0.037
29-Sep-90	117.67	6.00	0.089
30-Sep-90	63.08	*	*
01-Oct-90	156.56	12.38	0.112
02-Oct-90	195.08	13.17	0.049
03-Oct-90	81.23	*	*
04-Oct-90	14.52	*	*
05-Oct-90	7.49	*	0.056
06-Oct-90	26.05	*	*
07-Oct-90	17.38	*	*
08-Oct-90	51.99	*	*
09-Oct-90	99.97	*	*
10-Oct-90	26.69	*	*
11-Oct-90	25.57	*	*
12-Oct-90	88.08	*	*
13-Oct-90	63.86	*	*
14-Oct-90	42.57	*	*
15-Oct-90	61.80	*	*
16-Oct-90	52.93	*	*

* no data

SITE #3

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
17-Oct-90	51.94	*	*
18-Oct-90	87.57	*	*
19-Oct-90	243.03	14.60	0.101
20-Oct-90	67.49	*	*
21-Oct-90	118.48	14.11	0.106
22-Oct-90	104.70	13.00	0.105
23-Oct-90	65.50	*	*
24-Oct-90	*	*	*
25-Oct-90	111.87	15.29	0.304
26-Oct-90	53.77	*	0.190
27-Oct-90	65.45	*	*
28-Oct-90	92.95	*	*
29-Oct-90	62.34	*	*
30-Oct-90	95.73	*	*
31-Oct-90	106.29	8.66	0.213
01-Nov-90	68.39	*	*
02-Nov-90	67.79	*	*
03-Nov-90	42.30	*	*
04-Nov-90	31.69	*	*
05-Nov-90	78.75	*	*
06-Nov-90	75.80	*	*
07-Nov-90	125.77	24.22	0.104
08-Nov-90	62.16	*	*
09-Nov-90	53.18	*	*
10-Nov-90	50.66	*	*
11-Nov-90	33.89	*	*
12-Nov-90	46.02	*	*
13-Nov-90	50.36	*	*
14-Nov-90	51.24	*	*
15-Nov-90	41.69	*	*
16-Nov-90	39.18	*	*
17-Nov-90	17.37	*	*
18-Nov-90	44.14	*	*
19-Nov-90	35.89	*	*
20-Nov-90	18.08	*	*
21-Nov-90	22.90	*	*
22-Nov-90	17.85	*	*
23-Nov-90	18.90	*	*
24-Nov-90	26.53	*	*
25-Nov-90	23.67	*	*
26-Nov-90	*	*	*
27-Nov-90	26.14	*	*
28-Nov-90	19.73	*	*
29-Nov-90	16.11	*	*

* no data

SITE #4

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
01-Sep-90	93.68	*	*
02-Sep-90	33.94	*	*
03-Sep-90	113.52	9.39	0.066
04-Sep-90	264.15	12.01	0.122
05-Sep-90	220.78	19.80	0.044
06-Sep-90	222.07	12.13	0.071
07-Sep-90	287.35	12.16	0.025
08-Sep-90	157.54	14.26	0.060
09-Sep-90	172.39	15.21	0.068
10-Sep-90	247.90	8.92	0.094
11-Sep-90	241.86	25.41	0.075
12-Sep-90	124.23	16.81	0.148
13-Sep-90	156.61	17.66	0.207
14-Sep-90	188.82	4.92	0.031
15-Sep-90	117.20	8.11	0.040
16-Sep-90	42.22	*	*
17-Sep-90	104.06	17.61	0.250
18-Sep-90	94.14	*	*
19-Sep-90	75.14	*	*
20-Sep-90	104.09	9.64	0.058
21-Sep-90	117.96	10.79	0.038
22-Sep-90	107.37	14.62	0.096
23-Sep-90	109.06	2.02	0.000
24-Sep-90	168.64	6.89	0.132
25-Sep-90	222.56	16.72	0.079
26-Sep-90	204.05	11.15	0.277
27-Sep-90	214.60	11.71	0.114
28-Sep-90	233.39	10.33	0.061
29-Sep-90	*	*	*
30-Sep-90	102.10	14.21	0.098
01-Oct-90	261.19	12.06	0.076
02-Oct-90	313.13	23.93	0.028
03-Oct-90	170.33	9.07	0.111
04-Oct-90	8.00	*	*
05-Oct-90	13.10	*	*
06-Oct-90	83.18	*	*
07-Oct-90	46.94	*	*
08-Oct-90	94.94	*	*
09-Oct-90	172.53	12.64	0.137
10-Oct-90	25.65	*	*
11-Oct-90	71.49	*	*
12-Oct-90	129.15	22.84	0.135
13-Oct-90	96.37	*	*
14-Oct-90	109.67	13.21	0.464
15-Oct-90	159.93	10.38	0.456
16-Oct-90	136.12	28.71	0.278

* no data

SITE #4

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
17-Oct-90	118.68	16.88	0.157
18-Oct-90	160.09	10.64	0.132
19-Oct-90	252.58	11.61	0.086
20-Oct-90	158.28	12.91	0.281
21-Oct-90	147.41	11.48	0.044
22-Oct-90	185.81	12.66	0.250
23-Oct-90	139.03	12.06	0.224
24-Oct-90	203.94	7.28	0.324
25-Oct-90	241.07	18.85	0.183
26-Oct-90	129.69	23.93	0.295
27-Oct-90	109.36	7.57	0.159
28-Oct-90	160.32	8.67	0.137
29-Oct-90	124.82	11.21	0.174
30-Oct-90	266.70	7.10	0.269
31-Oct-90	232.14	4.58	0.244
01-Nov-90	204.72	39.98	0.430
02-Nov-90	193.13	9.94	0.516
03-Nov-90	65.77	*	*
04-Nov-90	60.10	*	*
05-Nov-90	166.42	6.71	0.741
06-Nov-90	129.54	9.70	0.280
07-Nov-90	144.73	3.60	0.052
08-Nov-90	51.40	*	*
09-Nov-90	37.84	*	*
10-Nov-90	39.51	*	*
11-Nov-90	22.14	*	*
12-Nov-90	43.64	*	1.732
13-Nov-90	40.45	*	0.465
14-Nov-90	44.59	*	1.118
15-Nov-90	66.39	*	*
16-Nov-90	47.71	*	0.579
17-Nov-90	26.07	*	*
18-Nov-90	116.08	7.15	0.919
19-Nov-90	65.32	*	*
20-Nov-90	24.40	*	*
21-Nov-90	23.47	*	*
22-Nov-90	25.36	*	*
23-Nov-90	21.53	*	*
24-Nov-90	51.59	*	*
25-Nov-90	30.60	*	*
26-Nov-90	48.08	*	*
27-Nov-90	38.87	*	*
28-Nov-90	47.78	*	*
29-Nov-90	19.03	*	*

* no data

SITE #5

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
01-Sep-90	13.70	*	*
02-Sep-90	7.36	*	*
03-Sep-90	12.70	*	*
04-Sep-90	44.50	*	*
05-Sep-90	38.66	*	*
06-Sep-90	46.91	*	*
07-Sep-90	39.23	*	*
08-Sep-90	47.60	*	*
09-Sep-90	43.63	*	*
10-Sep-90	37.21	*	*
11-Sep-90	70.26	*	*
12-Sep-90	13.82	*	*
13-Sep-90	30.62	*	*
14-Sep-90	39.45	*	*
15-Sep-90	74.35	*	*
16-Sep-90	13.32	*	*
17-Sep-90	15.74	*	*
18-Sep-90	20.29	*	*
19-Sep-90	13.26	*	*
20-Sep-90	15.28	*	*
21-Sep-90	46.23	*	*
22-Sep-90	70.50	*	*
23-Sep-90	55.71	*	*
24-Sep-90	60.92	*	*
25-Sep-90	26.89	*	*
26-Sep-90	26.18	*	*
27-Sep-90	36.40	*	*
28-Sep-90	69.93	*	*
29-Sep-90	16.03	*	*
30-Sep-90	47.25	*	*
01-Oct-90	91.93	*	*
02-Oct-90	13.68	*	*
03-Oct-90	25.22	*	*
04-Oct-90	6.15	*	*
05-Oct-90	3.62	*	*
06-Oct-90	7.84	*	*
07-Oct-90	6.68	*	*
08-Oct-90	11.61	*	*
09-Oct-90	8.26	*	*
10-Oct-90	3.73	*	*
11-Oct-90	15.34	*	*
12-Oct-90	9.07	*	*
13-Oct-90	7.82	*	*
14-Oct-90	6.90	*	*
15-Oct-90	27.70	*	*
16-Oct-90	17.23	*	*

* no data

SITE #5

Date Sampled	TSP Loading (ug/m^3)	Carbon Loading (ug/m^3)	BaP Loading ($ug/1000m^3$)
17-Oct-90	26.92	*	*
18-Oct-90	14.99	*	*
19-Oct-90	10.42	*	*
20-Oct-90	23.88	*	*
21-Oct-90	21.65	*	*
22-Oct-90	21.16	*	*
23-Oct-90	100.43	10.51	0.044
24-Oct-90	45.64	*	*
25-Oct-90	100.94	21.84	0.060
26-Oct-90	31.33	*	*
27-Oct-90	79.82	*	*
28-Oct-90	17.84	*	*
29-Oct-90	82.78	*	*
30-Oct-90	96.84	*	*
31-Oct-90	38.63	*	*
01-Nov-90	15.34	*	*
02-Nov-90	65.30	*	*
03-Nov-90	32.74	*	*
04-Nov-90	13.69	*	*
05-Nov-90	45.20	*	*
06-Nov-90	59.19	*	*
07-Nov-90	14.50	*	*
08-Nov-90	20.96	*	*
09-Nov-90	28.96	*	*
10-Nov-90	23.32	*	*
11-Nov-90	16.19	*	*
12-Nov-90	26.52	*	*
13-Nov-90	15.91	*	*
14-Nov-90	12.23	*	*
15-Nov-90	18.93	*	*
16-Nov-90	15.71	*	*
17-Nov-90	6.87	*	*
18-Nov-90	19.99	*	*
19-Nov-90	*	*	*
20-Nov-90	*	*	*
21-Nov-90	22.62	*	*
22-Nov-90	23.58	*	*
23-Nov-90	36.33	*	*
24-Nov-90	32.87	*	*
25-Nov-90	34.88	*	*
26-Nov-90	26.21	*	*
27-Nov-90	22.17	*	*
28-Nov-90	14.32	*	*
29-Nov-90	4.53	*	*

* no data